Aalto University
School of Business

STRATEGIC INVESTMENT APPRAISAL VIA DECISION-MAKING CONSTRUCT

A CASE STUDY IN THE FOOD MANUFACTURING INDUSTRY

Master's Thesis
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Valio is known as an innovative food industry company, whose R&D efforts cover the entire dairy value chain. As a response to trends in the dairy industry, Valio entered the vegan dairy replacements market with its Oddlygood® products in 2018 and sees that the significance of vegan products in its business will grow in the following years. To support its vegan dairy replacements business, Valio could establish production capacity for plant-based ingredient processing to benefit from increased vertical integration. In this thesis the establishment of such production capacity is referred to as the investment project.

This thesis studies the strategic and financial aspects related to the investment project in the field of plant-based ingredient processing with a focus on decision-making. This study is conducted with constructive research approach in the context of Valio, a large and integrated Finnish dairy and food manufacturing company. Constructive research begins with a practical problem and aims to solve it by innovating and implementing a solution. The solution is anchored in both theory and practice. This research provides a practical contribution by addressing the initial problem, and a theoretical contribution by reflecting on the process and findings in relation to theory.

This thesis proposes a decision-making construct which combines strategic and financial analysis. Strategic aspects of the investment project are addressed through a make-or-buy decision-making framework, while the financial aspects are addressed with a constructed cash flow-based Excel tool that models the operation of the proposed plant-based ingredient production facility. The use of the decision-making construct is also demonstrated using a hypothetical data set.

Keywords Investment appraisal, strategic investment decision making, make-or-buy decision

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Valio tunnetaan innovatiivisena maito- ja ruoka-alan toimijana, jonka tutkimus- ja kehitystoiminta kattaa koko maitoketjun. Valio toi markkinoille kasviperäisen Oddlygood® tuoteperheen 2018 vastauksena muuttuviin markkinaolosuhteisiin ja -trendeihin. Valio näkee, että kasviperäisten maitoa korvaavien tuotteiden merkitys sen liiketoiminnalle kasvaa tulevina vuosina. Yksi ulottuvuus, jolla Valion olisi mahdollista kehittää kasviperäisten tuotteiden liiketoimintaansa, olisi kasviperäisissä maitotuotteita korvaavissa tuotteissa käytettävien avainraaka-aineiden valmistuksen aloittaminen toteuttamalla tehdasinvestointi.

Tässä tutkielmassa tätä mahdollista tehdasinvestointia arvioidaan sekä taloudellisesta että strategisesta näkökulmasta. Tutkielman tarkoitus on auttaa strategisessa investointipäätöksenteossa. Tutkimus on toteuttu konstruktiivisella tutkimusotteella Valion kontekstissa. Konstruktiivisen tutkimuksen on tarkoitus vastata käytännön ongelmaan kehittämällä ja implementoimalla sekä teoriasta että empiriasta johdettu ratkaisu eli konstruktio. Tieteellinen kontribuutio konstruktiivisessa tutkimuksessa syntyy tutkimusprosessin ja tulosten reflektiosta olemassa olevaa tietämystä ja teoriaa vasten.

Tässä maisterintyössä esitellään päätöksentekokonstruktio, jolla investointiprojekteja voidaan arvioida. Strateginen analyysi on toteutettu tee tai osta (engl. make-or-buy) -viitekehyksen avulla ja taloudellinen analyysi tähän tarkoitukseen luodulla taulukkolaskentamallilla, joka kuvaa kassavirtapohjaisesti ja yksinkertaistetusti mahdollisen tehtaan toimintaa. Konstruktion käyttöä on myös demonstroitu hypoteettisen datan avulla.

Avainsanat Investoinnin taloudellinen arviointi, strateginen päätöksenteko, make-or-buy päätös

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1. Introduction

Valio, founded in 1905, is among the largest food manufacturing companies in Finland. The company was established as a cooperative by 17 member dairies to export Finnish butter. The first Valio laboratory was established in 1916[1]. Today Valio is known as an innovator in the food industry, consistently bringing over 100 new products to market annually. Valio is highly vertically integrated throughout the dairy value chain, meaning that Valio has control over the dairy value chain from the farm to finished branded products.

As a response to a declining trend in milk consumption and rising demand for vegan dairy alternatives, Valio entered the vegan dairy replacing products -market with its brand Oddlygood® in 2018. With its product development capabilities and strong brand Valio is in a good position to develop its vegan dairy alternative business. In this thesis vegan dairy alternatives and vegan dairy replacement products refer to plant-based products, which are designed to replace dairy products in the lives of consumers.

Currently, Valio's vegan dairy alternative business covers production in the value chain. Valio expects that the significance of vegan dairy alternatives will grow in Valio's product mix over time (Valio, 2020). Therefore, the question of vertical integration of Valio's vegan dairy alternatives value chain is timely and relevant. Valio could extend a step upstream in the value chain and enter the plant-based ingredient processing business, and produce ingredients used in its vegan dairy alternative products instead of buying them from outside.

This thesis provides a decision-making framework for Valio to analyse and evaluate financial and strategic factors of the potential establishment of a plant-based ingredient processing facility (the investment project).

[1] https://www.valio.fi/yritys/artikkelit/valio-ajan-hermolla-jo-vuodesta1905/ accessed 16.06.2020

1.1. Empirical background of the investment project

Valio has been a vertically integrated dairy company from its inception. The purpose of Valio is to serve its farmer-owners by purchasing milk at a high price and quantity. Valio faced a significant challenge in the early 1990s when the change of competitive legislation in Finland forced Valio to change its structure. As a result, Valio ltd. was founded in 1992. Three years later, as Finland joined the EU, the competitive landscape changed dramatically.

Lamprinakis, (2012) interviewed 13 managers, executives, past directors, and industry insiders to uncover what happened during this crucial time in Valio's history. Valio's heavy cost structure made it susceptible to European competition. Valio feared that products from other EU countries would flood the Finnish market (Lamprinakis, 2012). Valio would also lose on significant subsidies it was receiving from the Finnish government to support exporting to EU countries (Valio, 1996). Valio reacted to the new situation with two sets of strategies: proactive strategies and retrenchment strategies (Lamprinakis, 2012). Proactive strategies are externally focused and aim to capture new opportunities and prepare for anticipated threats, whereas retrenchment strategies are targeted internally and focus on operational efficiency and cost cutting. These are also referred to as exploitative and explorative strategies in management literature (e. g. Raisch & Birkinshaw, 2008; Porter, 1980).

It was evident for Valio that competing in the EU would require a shift toward the development of higher value products, as it did not seem feasible to compete with bulk, non-differentiated products against the cheaper imports (Lamprinakis, 2012). The entry barriers to the Finnish market were going to collapse, dramatically increasing dairy industry rivalry. Valio reacted proactively and exploratively by increasing investments in R&D to differentiate its offering from the cheaper bulk dairy products that were going to flood its main market. This meant a shift from *"a production company to a marketing company in the sense...that the key focus is to sell branded products to consumers and also to invest in R&D so that you can keep your production update... so that you remain competitive on the market"*, as one of Lamprinakis' (2012 p. 101) interviewees phrased it.

While Valio invested in R&D and marketing to support its transformation to a market driven enterprise, major action was taken to simultaneously streamline the organisation. This constituted the exploitative side of Valio's ambidextrous approach[2]. Valio group and its cooperatives shed over half of their 10,000 employees over an 8-year period to lighten its cost structure (Lamprinakis, 2012). In 1995 Valio (Valio, 1996 p. 4) reported that "the cornerstone of the competitivity of our dairy industry is a healthy cost structure compared with that of our competitors", and that the "transition to the new mode of operation took place gradually during the autumn, as profit-center type divisions were set up on the basis of product lines. The aim is to focus more clearly on the market and financial performance".

Exploration initiatives, being future oriented, brought people hope during times when cost cutting was necessary to improve business competitiveness. Lamprinakis (2012 p. 102) quotes another manager from Valio: *"...the restructuring period... it was very hard times, especially in the 1990s when plants were closing and so on... this has been a very very dramatic change and very hard times...many people lost their jobs and plants were closed... but always during this time extra attention was paid to marketing, brand building and we also made investments for these things even though we had to cut costs... so yes, we invested in R&D, marketing, brands and some development activities as well, even though we had to cut our costs…"*

Valio's responses to the changes in its operating environment can be considered successful (Lamprinakis, 2015). Valio's international sales decreased by -28,6% during 1994-1995 because of Finland converting from its domestic export subsidy system to the EU system. The international sales bounced back over the following two years, aided by the acquisition of a Belgian cheese factory, surpassing the pre-EU levels. Valio lost 20% of its domestic sales in Finland to increased competition 1994-1999 but gained the lost ground back over the following two years (Valio, 1995; Valio, 1998; Valio, 2002).

[2] Exploitation refers to the seeking of improved business performance from a firm's current activities, while exploration refers to the search of new business areas. Simultaneous execution of both exploitation and exploration is referred to as ambidextrous strategy (e.g. He & Wong, 2004; Raisch & Birkinshaw, 2008). Ambidextrous literally means two-handed strategy

Valio's revenue expectedly decreased by 13% from 1994 to 1999 but grew by 20% between 1999 and 2004 resulting in an 8% growth over a ten-year period from 1994 to 2004 overarching Finland joining the EU (Valio, 1995; Valio, 2000; Valio, 2005).

Valio was able to frontload many of the necessary changes because it had a very active and well-connected information network in Finland and abroad. This allowed Valio to analyse its competitiveness compared to other European dairy companies. Lamprinakis (2012) sees this data gathering and processing ability as the key element in Valio's rather successful transformation.

Currently, Valio is facing a new set of challenges. Valio has reported declining milk sales volumes consistently over previous years. For example in the 2018 annual report Valio reports that: "Population growth is slowing in the country, which means there is little potential for organic growth. Exports of fresh dairy products to other markets are limited by distance. Supply continues to exceed demand in global milk markets (Valio, 2019)."

Valio measures success differently compared to most companies and aims to increase the total amount it pays out to its owners in exchange for milk[3]. The milk price per litre grew from 0,37€ to 0,47€ from 2004 to 2012 but has since dropped back down below 0,40€. The volume of milk bought has dropped by 10% during 2004-2019. The total amount paid out to farmers was 732m€ in 2004, peaked at 907m€ in 2013 and has since dropped to 722m€ in 2019 (Valio, 2005; Valio 2014; Valio, 2020). This cannot be considered a desired outcome, although during previous years Valio has paid a few cents more for milk compared to Arla that operates with a similar logic in similar markets and thus provides the best comparison (Arla Foods, 2019).

However, Valio has been able to pay relatively high dividends of over 3% to its farmer owners annually over the last 20 years, even on years during which Valio endured losses (Valio, 2000; Valio, 2004, Valio, 2008; Valio, 2015; Valio 2019). Valio's net sales have grown from 1,582m€ (2004) to 1,787m€ (2019) (Valio 2004; Valio, 2015; Valio, 2019). This represent a 13% increase, while inflation during the same period was 27%

[3] It is common for companies to fundamentally pursue increasing of shareholder wealth. Valio instead aims to support the business of its dairy-owners. https://www.valio.fi/yritys/yritystieto/ accessed 22.06.2020

(Plecher/statista.com, 2020). Valio's asset value has grown from 841m€ (2004) to 1,122m€ (2019). This is an increase of 33% and represents a compound annual growth rate of 1.8% without, and 0.3% with inflation correction. The OMX Helsinki index has grown 160% during this period[4].

While the sales of basic dairy products have been flat or declining, Valio has reported increasing sales volumes of added-value products especially in foreign markets over the past three years (Valio, 2017; Valio, 2018; Valio, 2019; Valio, 2020). During this time, Valio's focus on international business has shifted towards value-added ingredients. In 2015, Valio was planning to build its international success especially on their branded consumer facing products (Valio, 2016). By 2017, this had shifted to new product categories and value-added products, and in 2020 Valio saw "international growth potential especially in value-added ingredients."[5] Valio's turnover in foreign markets grew from 577m€ (2016) to 715m€ (2019), up 24% in only three years (Valio, 2017; Valio, 2018; Valio, 2019; Valio, 2020). Valio highlights Sweden, the Baltics and China as growing markets. The sales of value-added ingredients to business customers grew by 30% in 2019, with sales in China growing by nearly 40%. On the 8th of April, 2020 Valio announced a partnership with Palmer Holland to bring lactose free powders to the United States[6], and on May 29th, 2020 Valio announced an exclusive distribution arrangement with Univar Solutions (an American Fortune 500 chemical and ingredient distributor) in 11 European markets[7].

Valio's emphasis on technical research and development has enabled the creation of differentiated dairy products and value-added ingredients while also enabling a licensing business model. Valio's licensing business is built on the knowhow and patents related to the LGG® lactic acid bacteria, and Valio's solutions for production of lactose free milk

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[4]http://www.nasdaqomxnordic.com/indeksit/historialliset_kurssitiedot?Instrument=FI0008900212 accessed 03.06.2020
[5]https://www.valio.com/news/valios-year-2019-exports-up-moderate-growth-in-net-sales-and-improvement-in-profitability/ accessed 02.06.2020
[6]https://www.valio.com/news/valio-and-palmer-holland-join-forces-to-bring-lactose-free-powders-to-the-united-states/ accessed 02.06.2020
[7]https://www.valio.com/news/univar-solutions-appointed-european-exclusive-distributor-of-valio-eila-lactose-free-milk-powders-in-a-multi-country-partnership/ accessed 02.06.2020

products. In 2015, Valio was licensing its technologies to 17 companies around the world (Leporanta, 2015). Lactose free products produced with technologies licensed from Valio were sold in 6 countries by 2015 and 14 countries by early 2020 (Leporanta, 2015; Kallioinen, 2020).

As the most recent adaptation, in 2017, Valio announced its entry to the dairy alternative market: “Progressively more people associate sustainable eating with a reduction in the consumption of meat and products of animal origin, often related to climate change or health. Vegan products are increasingly consumed by omnivores (those who do not follow any special diet) as alternatives to products of animal origin. Valio is responding to consumer demand with its oat-based Oddlygood® product innovations, launched in February 2018” (Valio, 2018 p. 1). Valio is also developing environmentally sustainable practices, aiming to make its milk carbon neutral by the year 2035 (Valio, 2020).

Valio is responding to its present challenges with a combination of explorative and exploitative strategies similarly to the ambidextrous approach Valio chose 30 years ago. The key exploitation and exploration initiatives of Valio in response to the challenges of 1990s and 2010s respectively are summarised in Table 1.

Year	Identified challenges	Exploitation	Exploration
1990s	• New anticompetition law • Finland joining the EU	• Personnel cuts • Cost cutting / organisational efficiency • Rationalisation • Shift to market orientation	• Investments in marketing • R&D of value-added products Brand development • Technology development

2010s	• Overproduction of milk • Declining dairy market trends	• Shift to contract farming • Cost cutting / reorganisation • Distribution partnerships for B2B sales in EU and USA • Technology licensing	• R&D in environmentally sustainable milk chain • Development of plant-based and value-added products • International markets

Table 1. Ambidextrous strategies at Valio in response to challenges of 1990s and 2010s.

In the next chapter the investment project is connected to a theoretical context.

1.2. Theoretical context of the investment project

The question of whether Valio should build a factory to produce plant-based ingredients for its products can be considered simply as an investment idea. This thesis approaches this question from an investment perspective. The possible establishment of such a facility is referred to as the investment project as this is the term used in investment decision making literature (e. g. Pike & Neale, 2006; Cooremans, 2011).

To assess whether an investment project is financially viable, a cash flow model must be established. Once the expected cash flows associated with an investment project are quantified, a myriad of investment appraisal methods can be applied to help in decision making. Investment appraisal methods include static methods, discounted cash flow methods and methods that assist in evaluating and quantifying risk associated with the investment (e. g. Götze et al., 2015; Alkaraan & Northcott, 2006; Pike & Neale, 2006).

Currently, the most commonly used investment appraisal methods (according to literature surveying industry practices) include the payback period, return on investment (ROI), accounting rate of return (ARR), net present value (NPV) and internal rate of return (IRR) (e. g. Alkaraan 2020; Huikku et al. 2018). The most used methods for conducting risk analysis are adjusting the required rate of return or payback period and sensitivity analysis (e. g. Huikku et al., 2018; Slagmulder et al., 1995; Abdel-Kader & Dugdale, 1998). The methods used in firms have remained largely the same for the previous 50 years (Alkaraan, 2020). It is common that multiple decision-making and risk analysis methods are used simultaneously in investment appraisal (e.g. Alkaraan, 2020; Verbeeten, 2006).

The investment project in this thesis is defined and considered as a strategic investment project because it would result in installation of new manufacturing processes and a substantial shift in production capabilities (Slagmulder et al., 2015; Alkaraan & Northcott, 2006). Therefore, the strategic implications associated with the investment project should be considered alongside profitability (e. g. Alkaraan & Northcott, 2006; Adler, 2000; Huikku et al., 2018).

Strategic investment projects can only be evaluated in their strategic context (e. g. Welch & Nayak, 1992; Hitt et al., 1998). Therefore, it is necessary to establish Valio's current situation, recent history, and challenges. As concluded in the previous chapter, Valio's response to current challenges is ambidextrous, as clear signs of simultaneous execution of exploitative and explorative strategies was found.

Simultaneous pursuit of both exploration and exploitation is considered challenging in strategy literature. A firm doing so runs at risk of being mediocre in both instead of excellent in either one (e. g. March, 1991; Porter 1980). Some scholars argue that since the market selects for excellence, firms should select between exploitation and exploration to be more focused and competitive (Porter, 1980; Barney, 1991). March (1991) however believes that despite the challenges involved with the ambidextrous approach, firms must pursue both exploration and exploitation simultaneously. Tushman & O'Reilly (1996) agree and argue that firms that successfully pursuing both strategies outcompete firms that do not. In two empirical studies both He & Wong (2004) who analysed 206 manufacturing firms and Gibson & Birkinshaw (2004) who analysed 41 business units in firms, found evidence that balancing both exploration and exploitation improves business performance.

The establishment of a plant-based ingredient factory could be considered both an exploitative and explorative initiative as it might bring cost savings while differentiating Valio's operations in new directions. Therefore, the investment project should be evaluated from both perspectives.

Strategic investment decision literature highlights that strategic investment projects produce hard-to-quantify (or intangible) outcomes that can have a significant long-term impact on performance (Alkaraan & Northcott, 2006: p. 150). Especially investments in technology and R&D often provide firms with future opportunities which were not anticipated nor placed value on when investment decisions to develop the technologies were being made (Ziedonis, 2007; McGrath, 1997). Valio's recent success in B2B value-added ingredient sales and technology licensing is an example of the realisation of such unseen opportunities, originating from earlier investments aimed at developing added-value consumer facing dairy products.

In this thesis the question of whether Valio should begin making its own plant-based ingredients for its products is considered as a make-or-buy decision. The make-or-buy decision has been studied extensively and from multiple different theoretical directions. Both Dibbern et al. (2004) and Serrano et al. (2018) identify nine theories used in understanding make-or-buy decisions in their reviews of make-or-buy decision literature. The most common theories explaining make-or-buy decisions in make-or-buy literature are transaction cost economics (TCE) and resource-based view (RBV) (Dibbern et al., 2004; Serrano et al., 2018). In this thesis both TCE and RBV will be used jointly to evaluate the strategic and non-financial elements of the investment project (while the other theories are not included in the analysis).

Both TCE and RBV tie into competitive advantage. The TCE approach to the make-or-buy decision asks whether the firm can facilitate an operation more efficiently than the market (Coase, 1937; Williamson, 1975). TCE strands from economics and ties to the efficiency of the market in question. The more efficient the market[8] is, the less likely it is

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[8] An efficient market is one where no firm can gain excess rents by exploiting market imperfections, such as asymmetries in information.

that a firm could outcompete it. For the make-or-buy decision this is referred to as risk for opportunism (e. g. Williamson, 1975). In situations where it is likely that a firm is paying too much for goods or services as a result of market imperfections, TCE advises making the goods or services instead of continuing to buy them (e. g. McIvor, 2009).

RBV on the other hand asks whether the firm holds resources that make it more capable in performing an operation compared to other market players (Barney, 1991; Eisenhardt & Martin, 2000). In RBV, resources refer to all assets, capabilities, organisational processes, firm attributes, information, knowledge etc. held by a firm (Barney, 1991). RBV advises that firms should focus on making goods and services that they have a competitive advantage in making (e. g. McIvor, 2009).

While the make-or-buy decision framework fits well into the strategic analysis of this case, it assumes that the strategic choice is indeed between making (total ownership of the production process) or buying (no ownership of the production process) the ingredients necessary for the manufacturing of Valio’s current or future products. An alternative to these modes would be an arrangement in which the ownership of the production process is controlled partially, such as a joint venture arrangement with another firm. Such a partnership might be strategically appealing as joint ventures can provide firms with cost savings, fast access to new markets, risk sharing and ability to borrow expertise of partners (Doz et al., 1990).

From the RBV perspective the make-or-buy decision framework assumes that a clear competitive advantage is or can be held by either the firm or the provider of the goods or services in question (e. g. Barney, 1991). In the case of TCE, the question of interest in the make-or-buy decision is whether a firm can gain a competitive advantage over the market at such by internalising or externalising a process (e. g. Williamson, 1975).

Dyer & Singh (1998) develop a widely respected theory that a network of firms can develop relationships that result in sustained competitive advantage. This perspective is missing from both TCE and RBV perspectives. While acknowledging this shortcoming and merit of the relational view to competitive advantage, it is excluded from further review in this thesis. This is done for two reasons: 1. to maintain the practicality of the crafted decision making framework and 2. due to inability to access data that would allow the evaluation of potential strategic relationships Valio could enlist or seek to resolve the presented make-or-buy decision.

1.3. Research questions

This thesis brings together make-or-buy decision making and strategic investment decision making literature to develop a decision-making framework. This framework is then employed to generate recommendations to Valio on whether or not it should realise the strategic investment project and establish a facility to make plant-based ingredients.

This thesis answers the following research questions:

> *RQ1:* How should the decision of investing in a plant-based ingredient processing facility at Valio be taken according to recent make-or-buy decision and strategic investment decision making literature?
>
> *RQ2:* Should Valio invest in a plant-based ingredient processing facility based on the data that could be gathered?

1.4. Structure of this thesis

This first part of this thesis reviews literature regarding the make-or-buy decision, strategic investment decision-making, and methods used in investment appraisal and risk analysis. From this literature a decision-making framework consisting of a financial and a strategic lens is created.

The strategic lens consists of findings from literature considering the make-or-buy decision and the strategic investment decision. The make-or-buy decision will be discussed in chapter 2.1 and the strategic investment decision making including methods for financial and risk analysis of investment projects in chapter 2.2.

Once the financial and strategic lenses are constructed, they will be applied in the analysis of the investment project at Valio described above. The constructive research methodology used in this thesis is described in chapter 3, and the results of the analysis in chapter 4. In chapter 5, the results and the achieved contributions are discussed and finally, in chapter 6, conclusions are presented.

2. Literature review

In this literature review section, the theoretical background of the study is elaborated on further. First the main theories associated with the make-or-buy decision are covered, followed by an introduction to the most significant methods for analysing the economic viability of investment projects. This is also known as investment appraisal, which is the term that will be used hereafter.

2.1. The make-or-buy decision

Serrano et al. (2018) analysed 99 articles published in renowned academic journals to paint a picture of academic findings regarding the make-or-buy decision over the past 30 years. They found nine theories that are used in the analysed articles to explain make-or-buy assessments. The same list of theories was found earlier by Dibbern et al. (2004) in their review of information systems outsourcing literature. The three most popular theories in the research conducted by Serrano et al. (2018), are the resource-based view (65/99 articles), transaction cost economics (62/99 articles) and strategic management theories (56/99 articles) with nearly half of the 99 articles being structured around a combination of these three theories. The remaining six theories are relationship theories, agency theory, social exchange theory, game theory, innovation theory and power and politics theories (Serrano et al., 2018; Dibbern et al., 2004).

While these six theories provide valuable and unique insight into the make-or-buy decision dynamic, especially regarding interfirm relationships, they will be excluded from further review because these theories either do not directly touch on vertical integration or would delve into the relations Valio has with its suppliers, which is outside the focus of this thesis.

In the following sections a make-or-buy decision-making construct based on transaction costs economics and the resource-based view literature is constructed.

2.1.1. Transaction cost economics

Transaction cost economics (TCE) is a theory that explains the emergence of firms and why some firms outcompete other firms. According to TCE the source of competitive advantage is in the ability to conduct business operations with lower transaction costs than the market or other firms (Coase, 1937, Williamson, 1975). The TCE approach to the make-or-buy decision is built on concepts of limited or bounded rationality and chance for opportunistic behaviour between market collaborators (Dibbern et al., 2004; McIvor, 2009). By bounded rationality scholars mean to say that decision making is inherently imperfect because not all information relevant to a decision can be known and even all the information that is known cannot be successfully incorporated in decision making (e.g. Williamson, 1975, March 1978, Dibbern et al., 2004). Opportunism in the context of TCE refers to "an effort to realize individual gains through a lack of candor or honesty in transactions" (Williamson, 1975 p. 107).

In his article "the Nature of the Firm" Coase (1937) proposes that the existence and growth of firms can be explained by transactions costs. Coase explains that in the economy it is the market mechanism that performs economic tasks and that firms are not mandatory for these economic tasks to be completed. The execution of these tasks however carries a transaction cost, which creates opportunities for firms to undertake economic tasks more efficiently than the market could without organisation. With a similar logic economic tasks that were previously conducted by two or more firms could be conducted by one firm if that one firm can organise the tasks more efficiently than the many could. This is the origin of the notion of integration along a value chain: "There is a combination when transactions which were previously organised by two or more entrepreneurs become organised by one. This becomes integration when it involves the organisation of transactions which were previously carried out between the entrepreneurs on a market" (Coase, 1937 p. 397-398).

The key principle in Coase's thinking on the expansion of a firm's activities is that by organizing more economic activity in the same firm, a higher efficiency and with that a competitive advantage can be gained. Since everything in the world is not organized by a single firm, there must however be diminishing returns or downsides to scale at play. Coase suspects that one of the key reasons might have to do with the firm's ability to continue to place the factors of production in the uses where their value is greatest (Coase, 1937). As a firm attempts to organise more and more transactions, the transactions grow more spread out in space and dissimilar in nature. This leads to lower efficiency as the firm gets more complicated and causes more losses through mistakes as a result of bounded rationality (March, 1978). Therefore, the eternal dilemma for businesses is to conclude "will it pay to bring an extra exchange transaction under the organising authority?" (Coase, 1937 p. 404).

One variant of this problem is the make-or-buy decision. Coase hypothesises that technologies that enable more efficient and cheaper organisation of activities over distance (such as the telephone and telegraph) cause firms to grow larger: "All changes which improve managerial technique will tend to increase the size of the firm" (Coase, 1937 p. 397). This implies that good managerial technique and use of technology can lower the costs of conducting transactions within a firm. This makes the firm more competitive and enables it to grow larger. By extension, a firm with good managerial technique will be more successful in pursuing vertical integration.

The make-or-buy decision is fundamentally a question of the extent to which a firm should pursue vertical integration. In traditional economics vertical integration is viewed as an attempt to increase profits by controlling input markets or distribution channels (Klein, 2005) or even as a strategic manoeuvre to achieve anticompetitive effects (Williamson, 1971). The transaction cost approach pioneered by Coase (1937) and greatly developed by Williamson (1971, 1975) emphasises that vertical integration can be an efficient means of organizing production and only works when a firm can indeed improve its efficiency by making instead of buying.

The TCE approach is grounded in macroeconomics and the principle of the efficient market (Coase, 1937; Williamson, 1971). Therefore, as general advice TCE scholars encourage the use of a market exchange over internalized processes when there are no good reasons to do otherwise: “Mainly on account of bounded rationality and greater confidence in the objectivity of market exchange in comparison with bureaucratic processes, market intermediation is generally to be preferred over internal supply in circumstances in which markets may be said to work well (Williamson, 1971 p. 113)”. The exception are cases where potential for opportunism is high (Dibbern et al., 2004; Serrano, 2018; McIvor, 2009).

The key concepts behind the level of potential for opportunism and thus the practical application of the TCE approach in the make-or-buy decision are the level of uncertainty and asset specificity (Williamson, 1975). In traditional TCE high asset specificity refers to a situation where a buyer of a product or service has assets that require that specific product or service to be useful. In more academic words: the buyer holds transaction specific assets that are non-redeployable and specific to a task (Williamson, 1975). A hypothetical example of high asset specificity in the Valio investment project context would be a plant-based ingredient that Valio buys from another firm and that is essential for manufacturing several products. Without that specific plant-based ingredient all the machinery used to make the products in question would be rendered useless. The asset would be even more specific if its production required access to a technology only held by a very limited number of manufacturers. In such a situation the seller of the plant-based ingredient vital in Valio’s operation could benefit greatly from opportunistic behaviour, such as raising prices. Therefore, the risk for opportunism is heightened.

High level of uncertainty also contributes to higher risk for opportunism from the perspective of the buyer (Williamson, 1975). High uncertainty makes it more difficult and expensive for the buyer of a product or service to evaluate the supplier’s actions (Walker & Weber, 1987). Both high asset specificity and high uncertainty force buyers to shield themselves from risks. This can mean more and more complicated contracts, establishment of contingency plans, holding of extra inventory, increased need for communication etc. All these factors increase the transaction costs, thereby making it more likely that the firm could gain efficiency benefits by making instead of buying. These factors, however, are not static nor exclusively external, even though TCE is primarily an outward facing theoretical lens. For example, skilful and knowledgeable procurement personnel often build relationships with suppliers that enable trust and cooperation (Brewer et al, 2013), which might lower transaction costs of conducting business between firms.

Hill (1990) argues that the threat of opportunism in markets in exaggerated in TCE. He reasons that the market mechanism weeds out opportunistic behaviour. This is true especially in mature and sophisticated markets. Hill (1990 p.511) notes three scenarios in which the threat for opportunism are heightened: 1. when the outcomes of transactions are uncertain, 2. when the reputation of market actors are difficult to establish and 3. when the short-term gains of opportunistic behaviour are very large.

TCE has been criticised for its assumptions regarding opportunism, which can be considered a stronger form of the self-interest assumption common in economics and social sciences (e. g. Ghoshal & Moran, 1996).

As a summary, the key findings of TCE literature are:

> Vertical integration is generally not advisable, because market intermediation is preferred due to its efficiency.
>
> As an exception, vertical integration is advised when market intermediation carries high transaction costs. High transaction costs occur when risk for self-centred opportunistic behaviour between firms is high. This risk is high when: 1. The level of uncertainty associated with a supplier or a transaction is high. 2. Bought product or service has a high asset specificity. 3. Short-term gains for opportunistic behaviour are very large.
>
> The problems of mitigating uncertainty and suffering potential supplier opportunism are both reduced when the buyer has unilateral control over the transaction by producing the product or service in-house (Walker & Weber, 1987).

In conclusion: according to the transaction cost approach, a firm should make if the level of potential opportunism is high and buy if the potential for opportunism is low (e. g. Serrano et al., 2018; Walker & Weber, 1987; Williamson, 1975).

2.1.2. Resource-based view

The most supported theory used to explain how firms take make-or-buy decisions in Serrano et al.'s (2018) survey is the resource-based view. Resource-based view integrates closely with strategic management theories (third most popular theories in the Serrano et al., 2018 ranking), which highlight that the make-or-buy decision should be taken in accordance with the firm's strategic aims (Dibbern et al., 2004; Serrano et al., 2018). Classic management theories such as Porter's (1979) Five-Forces model or Ansoff's (1965) cascade model or take on strategic management (1980) are common in the literature. Classic definitions for strategy are used, such as Chandlers (1962 p. 13) definition of strategy as "the determination of the basic long-term goals and objectives of an enterprise, and the adoption of courses of action and the allocation of resources necessary for carrying out these goals."

The key strategic concept in the make-or-buy decision is competitive advantage as firms ultimately choose between options in hopes of attaining improved business results (e. g. Serrano et al., 2018; Dibbern et al., 2004). Jay Barney's 1991 article titled "Firm Resources and Sustained Competitive Advantage" brings prior literature on competitive advantage together and builds a theory that can be used to explain success of some firms over other. This theory is known as the resource-based view on strategy. Barney's theory is that the competitive advantage of a firm originates from the resources it controls. By resources Barney (1991 p. 101) means "all assets, capabilities, organisational processes, firm attributes, information, knowledge etc. controlled by a firm". By Barney's (1991 p.102) definition a firm holds a competitive advantage when it is "implementing a value creating strategy not simultaneously being implemented by any current or potential competitor". This advantage can be considered a sustained competitive advantage when rival firms could not implement the firm's strategy even if they wanted to (Barney, 1991).

Essentially this implies that a competitive advantage is sustained if rival companies lack the resources to implement the firm's strategy. This is referred to as a high resource position in make-or-buy literature (e. g. Serrano et al., 2018; McIvor, 2009). A low resource position on the other hand describes a setting where a firm does not hold resources that give it advantage in producing a product or service in contrast to rival firms.

The resource-based view is a very practical and suitable view regarding the make-or-buy decision as the make-or-buy decision has direct implications regarding a firm's resources. The logic of how firms should decide between making or buying a product or service can summarised in accordance with Barney's (1991) theory as follows: Making instead of buying implies that new production capabilities are established in exchange for other resources. For example, liquid assets (money) are deployed in the construction of a factory. If the gained capabilities as resources are worth more than the resources given up, the total amount of resources held by the firm increases. Since the resources held by a firm dictate its competitiveness, the firm should choose to make or buy based on which option leads to the highest total amount of resources held by the firm.

Not all resources should be considered equal when evaluating a firm's resource position. In order for a resource to provide competitive advantage to its holder it must have four attributes: 1. it must be **valuable**, meaning that it exploits opportunities or neutralises threats in a firm's environment, 2. it must be **rare** among current or potential competitors, 3. it cannot be easily **imitated** and 4. the resources must be **non-substitutable**, meaning that there must not be any other strategically equivalent resources that could be utilized in a similar way or for similar gains (Barney, 1991). A resource that satisfies these four criteria established by Barney (1991) are known as VRIN[9] resources (valuable, rare, inimitable, non-substitutable).

When a firm is holding VRIN resources that can be deployed to exercise a novel strategy, its resource position is high (Brewer et al., 2013). From the resource-based point of view

[9] In some recent articles (e.g. Eloranta & Turunen, 2015) the more traditional VRIN is replaced with VRIO, standing for value, rarity, imitability, and organisation. The idea remains unchanged. In this thesis, VRIN is used following the lead of key articles used in theory formulation (e. g. Brewer et al., 2013).

firms should aim to make products and services that they have a competitive advantage (originating from VRIN resources) in making. Likewise, firms should avoid making products or services that they have no resource-based advantage in making if they can avoid it. These two positions are known as a weak and strong resource position (McIvor, 2009; Brewer et al., 2013).

Kraaijenbrink et al. (2010) review the critique RBV has accumulated. While they note that some of the critique, for example claims that RBV has no managerial implications or that sustainable competitive advantage is in itself unattainable were in Kraaijenbrink et al.'s (2010) view easily dismissed there are three credible strands of critique. The first one is a notion that VRIN resources might not be necessary nor enough for a firm to gain a competitive advantage. This critique stems from the notion that holding resources is not enough, because a firm must also be able to deploy them. A firm could also gain an advantage by leveraging resources held by other firms. The act of deploying or leveraging resources would therefore be the source of competitive advantage. Insofar this capability is not itself a resource held by the firm, RBV would fail to explain the source of competitive advantage.

This has led to the development of the concept of dynamic capabilities, which explains that competitive advantage stems from "the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments" (Teece et al., 1997). For the practical application of RBV it is important to note that while holding resources can be a source of competitive advantage it might not be the only way a competitive advantage can be held. For the purposes of evaluating the investment project in this thesis RBV remains a useful theoretical tool, as it might help generate understanding on how realising the investment project could lead to Valio holding resources that improve its competitiveness in the future.

The second strand of RBV critique deemed worthy by Kraaijenbrink et al. (2010) is that cause and effect can be confused in RBV because the resources a firm holds and the competitive advantage it gains as a result are both described with same concepts. As a result, RBV can be seen as tautological: a firm must have unique and valuable resources because it is implementing an unique and value adding strategy. This problem has been addressed (e. g. Peteraf & Barney, 2003), providing some clarity on the issue but in Kraaijenbrink et al.'s (2010) view the problem persists. As a result of the tautology problem associated with RBV they advise that RBV should be considered rather as a heuristic than a substantial theory explaining competitive advantage. For the purposes of this thesis, this critique does not undermine the usefulness of the RBV as a point of view that can be utilised in decision-making.

The final critique credited with credence by Kraaijenbrink et al. (2010) has to do with the definitions of resources in RBV. Nearly anything can be considered a resource in RBV, which while making the theory applicable and theoretically correct weakens its explanatory powers and is the origin of its problem with tautology. Over time the pool of things that can be considered resources has expanded as scholars have tried to patch in shortcomings of the RBV (Kraaijenbrink et al., 2010). One of these additions is the aforementioned concept of dynamic capabilities, which aims to extend and enhance RBV (Eisenhardt & Martin, 2000).

While the critique facing the RBV is well founded, it remains one of the most influential theories explaining competitive advantage (e. g. Eloranta & Turunen, 2015; Eisenhardt & Martin, 2000) and the most popular theory used in the study of make-or-buy decisions (Serrano et al., 2018; Dibbern et al., 2004). For the purpose of this thesis, the resource-based view helps focus attention to 1. how resources held by Valio contribute to the attainment of competitive advantage in plant-based ingredient processing and 2. how Valio's resource position in this regard could change as a result of executing the investment project.

The advice RBV provides practitioners regarding the make-or-buy decision is to make when the resource position is strong (high) and buy when the resource position is weak (low) (e.g. Brewer et al., 2013; McIvor, 2009).

2.1.3. Crafting a make-or-buy decision-making construct

Serrano et al. (2018), observe a trend of scholars combining multiple theories to resolve the make-or-buy dilemma. McIvor (2009) advocates the combined use of the resource-based view (RBV) and transaction cost economics (TCE) to form a more holistic strategic decision-making framework. While RBV is an effective theory in developing understanding on how manufacturing decisions impact the resource position and competitive advantage of the firm, TCE provides a framework for assessing how interdependencies and process idiosyncrasies create potential for opportunism (McIvor, 2009). These approaches can be considered synergistic as the resource focus is inherently internally facing, while the evaluation of potential partner firm opportunism deals with external factors and risk. Brewer et al. (2013 p. 91) employ a similar theoretical lens by combining TCE and RBV approaches to evaluate outsourcing (a kind of make-or-buy) decisions: “Out of the number of theoretical lenses utilized to study outsourcing, TCE and RBV are the two most directly connected”.

Figure 1 below summarises the recommendations that can be derived from RBV and TCE literature regarding the make-or-buy decision. When resource position is strong and potential for opportunism is high, both TCE and RBV recommend making instead of buying. When resource position is weak and opportunism is high, both approaches recommend buying instead of making. In the other scenarios the recommendations diverge, as either the internal or external view supports making while the other one supports buying.

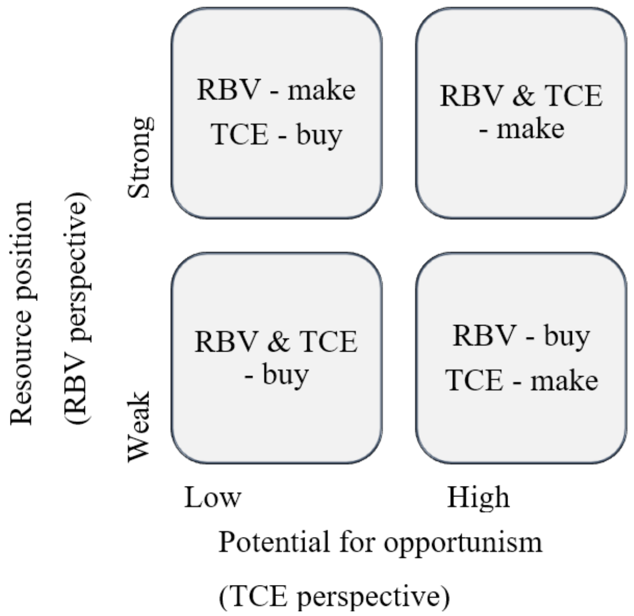

Figure 1. TCE-RBV matrix for the make-or-buy decision (inspired by McIvor, 2009)

Combining the resource-based view with transaction cost economics yields a framework that has similarities with the popular SWOT (strengths, weaknesses, opportunities, threats) analysis framework. Both provide a mix of internal and external consideration and encourage strategic thinking. In the case of the make-or-buy decision the TCE-RBV matrix has the benefit of containing selection criteria that have academic and empirical support (Serrano et al., 2018; Brewer et al., 2013). This framework can be, with some reservations, directly applied in the making of make-or-buy decisions.

2.2. Strategic investment decision making

Allocating resources between alternative investment projects is one of the most crucial tasks of top management and the primary means of implementing a firm's strategy (e. g. Slagmulder et al., 1995; Verbeeten, 2006; Pike & Neale, 2006). Firms undertake two kinds of investment projects: operational and strategic investment projects. In strategic investment decision making literature, operational investment projects are also referred to routine investment projects. This highlights their nature as sources of efficiency but not new direction (e. g. Alkaraan & Northcott, 2006). Strategic investment decision making refers to the process of identifying, evaluating and selecting among projects that are likely to have a big impact on a firm's competitive advantage (Adler, 2000 p.15).

Strategic investment projects and routine investment projects should not be treated the same in firms as choosing the right strategic investment projects is more crucial to the success of the firm (e. g. Alkaraan & Northcott, 2006). Due to the strategic nature of this investment project, the strategic implications associated with the investment project should be considered alongside profitability (e. g. Alkaraan & Northcott, 2006; Adler, 2000; Huikku et al., 2018).

The investment project evaluated in this thesis is considered strategic as it would result in installation of new manufacturing processes and result in a substantial shift in production capabilities (Slagmulder et al., 2015; Alkaraan & Northcott, 2006). Instead of touching on the entire strategic investment decision making process this thesis focuses only on the evaluation and selection stages, as the prospect investment project has been pre-selected for evaluation previously.

The TCE-RBV framework established in the previous chapter can be used to assess the strategic and non-financial implications of the investment project. In this chapter methods for assessing the financial aspects of strategic investment decision making are reviewed.

2.3. Methods for investment appraisal

Investment appraisal is the activity of economically evaluating an investment opportunity. It is commonly assumed that the paramount objective of a firm is to create as much wealth as possible by wisely deploying its resources (Pike & Neale, 2006). Investment appraisal is a process that seeks the investment opportunity that provides the highest increase in wealth creation. This process is also known as capital budgeting: "Capital budgeting refers to the host of techniques used to analyse the profitability of investment alternatives" (Moss, 2013 p. 194).

Traditional approaches to investment appraisal for strategic investment projects include the payback period, accounting rate of return, internal rate of return and net present value

(e. g. Adler, 2000; Alkaraan & Northcott, 2006). The basic idea of these methods is to score alternative investment projects to assess which one is the most desirable from a financial perspective.

All investment appraisal or capital budgeting methods produce results and insights that in their quality mirror the quality of the data used. Making predictions from data can be difficult and time consuming, and will always carry unreliability that results from both the possible invalidity of the assumptions in the data and the model that is used to analyse it (Götze et al., 2015). Although all investment appraisal methods rely on some extent on an assumption of certainty, many elements in the data will be unreliably estimated (Götze et al., 2015). Therefore, it is important to conduct clear headed analysis by using multiple methods that reveal different facets of the investment project or opportunity. Additionally, analysing results' sensitivity to change is important to understand the gravity of possible inaccuracies in the data or the assumptions used in the analytical model.

Shared assumptions among all the investment appraisal methods reviewed in this chapter include (Götze et al., 2015):

1) The data used in modelling the investment projects and the linkages between data points are known with certainty.
2) All relevant effects can be isolated and allocated to an investment project. All cash flows can be forecasted.
3) Different investment projects have no relationship or causalities between them other than mutual exclusivity.
4) Decisions about financing and production are made before the investment decision (and are thus known with certainty when the investment appraisal methods are used).
5) The economic life of the investment projects is known.

Only data that can be expressed as cash flows with relative ease can be included in the analysis (e. g. Slagmulder et al., 1995; Adler, 2000). As a result, investment appraisal techniques are commonly criticised for narrow perspectives, exclusion of nonfinancial benefits and overly emphasising short-term gains (e. g. Adler, 2000). Investment appraisal techniques should therefore be accompanied by other means of assessment when making strategic investment decisions.

2.3.1. Static methods

The simplest methods for investment appraisal are the static methods. In literature these methods might also be titled as “less sophisticated techniques” (e. g. Alkaraan, 2020). These methods focus on a single financial measure and are static in nature, meaning they ignore the passage of time (Götze et al., 2015).

Accounting rate of return

The accounting rate of return method combines a capital measure with the profit measure in the profit comparison method. This zooms in on a key metric regarding any investment: the profits that can be gained relative to the capital required to gain them. This ratio is called return on investment, or ROI (Pike & Neale, 2006). It is calculated as:

$$ROI = \frac{Profit\ before\ interest\ and\ tax}{Invested\ capital} x\ 100$$

This ratio indicates a company’s efficiency in churning profits out of its asset base.

The accounting rate of return (ARR) aims to provide a measure of a projects profitability compared to invested capital over the lifespan of the project (Pike & Neale, 2006). It compares the average profit of the project to the capital invested to generate those profits. The accounting rate of return can be calculated by dividing the average annual profit of the project by either the invested capital, or the average capital invested to the project in cases where this is more meaningful (Pike & Neale, 2006):

$$ARR = \frac{Average\ annual\ profit}{Invested\ capital} x\ 100$$

A key benefit of this measure of profitability analysis is that managers feel that they understand it (Pike & Neale, 2006). In a survey covering 150 large manufacturing companies in Finland Huikku et al. (2018) report that 37% of surveyed companies use ARR as one of the key methods used in investment appraisal. The data in this study was gathered during 2008-2011. ARR tackles directly into the core of business decision making by providing a ratio that answers how much bang for the buck can be expected from a project (Pike & Neale, 2006). Despite this strength, ARR does have definite drawbacks. It takes no account of size and lifespan of the investment, nor the timing of cash flows. It also averages out all profits, which can be very dangerous especially since the temporal dimension is not accounted for in any way (Pike & Neale, 2006).

Payback period

The payback period is an investment appraisal method in which the profitability of a project is evaluated against the required capital investment to initiate the project (Götze et al., 2015). It is the most common and widely used of the static investment appraisal methods. In fact, in many survey studies the payback period method has been found as the most widely used investment appraisal method in firms (e. g. Alkaraan, 2020, Alkaraan & Northcott, 2006). In the aforementioned study, Huikku et al. (2018) report that 94% of surveyed companies view the payback period method to be one of the key methods used in investment appraisal, while 63% considered the payback period to be the single most decisive financial criteria in investment decision making.

The ratio of average annual cash flow surpluses is compared with the required capital to produce an amount of time units the project must run to produce enough profits to pay back for the initial investment. The payback period is the period of time taken for the future cash flows generated by the project to match the initial cash outlay (Pike & Neale, 2006). This moment in time is also known as the breakeven point (Pike & Neale, 2006). Many companies set payback requirements for their investments and the method is commonly used among managers (Pike & Neale, 2006).

Scholars warn about over-emphasising the payback period method in decision making: "It must be emphasised that the payback period method should not be used as an exclusive decision criterion because it fails to incorporate any profits or cash flows occurring after the payback period" (Götze et al., 2015 p: 44). Additionally, the payback period method ignores the time value of money completely (Pike & Neale, 2006). In fact, the payback period method has been criticised for its poor credentials from the academic perspective at least since Joel Dean's article "Better Management of Capital Expenditures Through Research" in 1953 and this critique continues today.

The methods discussed next address the flaws of the payback period method.

2.3.2. Discounted cash flow methods

When comparing cash flows that occur at different times, an interest rate is used (Götze et al., 2015). The future value of a cash flow event can be calculated with the following formula, where *FV* is the future value of a cash flow event V_0 *n* years from now that grows at an interest rate of *i* per year.

$$FV_{(i,n)} = V_0(1+i)^n$$

As an example a cash flow event of V_0 = 100€ with an interest rate of n = 10% would grow 10% the first year to $FV_{(10\%,1)}$ = 100€ * (1 + 10%) = 100€ * (110%) = 110€. The following year the interest compounds: $FV_{(10\%,2)}$ = 100€ * $(1+10\%)^{2 =}$ 100€ * 121% = 121€. The fact that interest rates compound from year to year make them very powerful when time spans grow longer.

In investment appraisal cash flows taking place at different times in the future must be made comparable. This can be achieved by modifying the formula above to calculate the present value of a cash flow event with the following formula:

$$V_0 = \frac{FV_n}{(1+i)^n}$$

From the point of view of investment appraisal, investment projects are characterised by a serious of cash inflows and outflows over several time periods, commonly starting from a larger cash outflow followed by smaller inflows and outflows (Götze et al., 2015). The discounted cash flow methods described in this chapter, function by moving all future cash flows to the present moment at time = 0 by discounting them with a discount rate. This way these discounted cash flow methods recognize more than one time period and acknowledging the time value of money (Götze et al., 2015; Pike & Neale, 2006).

The interest rate that should be used when analysing cash flows at different time horizons thus has two parts: a risk-free rate of return that covers for inflation and rewards the investor for using the money for something else and a compensation for the risk associated with the investment (Pike & Neale, 2006).

Net present value

A project's net present value is calculated by summing all future discounted cash flows related to an investment project back in time to the start of the project or time 0 and deducting the initial investment that was used to initiate the project (Götze et al., 2015; Pike & Neale, 2006). The present values of the cash flows of each year are summed and the initial investment *I* is deducted:

$$NPV = \sum_{t=1}^{n} \frac{X_t}{(1+k)^t} - I$$

Here k is used instead of i as the symbol for the interest rate used in the present value calculation. Whereas *i* is commonly used as a symbol for the general market interest rate, *k* refers to the rate of return that the firm sets as a target during the investment appraisal process (Pike & Neale, 2006). The use of k is more appropriate in the net present value formula as k reflects not only the market interest rate but the risk associated with the investment. The core concept of the net present value can be used in other discounted cash flow methods.

In a survey covering 150 large manufacturing companies in Finland Huikku et al. (2018) report that 57% of surveyed companies use NPV as one of the key methods used in investment appraisal. 20% of the companies considered NPV to be the most decisive method used in investment decision making. The data in this study was gathered during 2008-2011. The reason for the success of the net present value is in its direct connection to the paramount objective of the firm: wealth creation (e. g. Pike & Neale, 2006).

A positive net present value indicates that the investment project in consideration will increase the wealth of the firm as long as the assumptions underlying the investment appraisal process hold true. A rational decision maker should undertake such a project. When making decisions between mutually exclusive investment projects (for example the firm's resources are not plentiful enough to realize more than one of the options) the highest net present value option should be chosen, as this will lead to the greatest increase in wealth.

Internal rate of return

An alternative approach for acknowledging interest rates in investment appraisal is the internal rate of return (IRR) method (Pike & Neale, 2006). In this method the goal is to calculate a return rate for the investment opportunity at hand. This is done by finding the rate that equates the present value of future benefits to the initial cash outlay by solving *r* in the net present value formula when NPV = 0.

$$\sum_{t=1}^{n} \frac{X_t}{(1+r)^t} = 0$$

Due to the sigma function it is not meaningful to calculate the exact internal rate of return by hand especially for a longer time series. Instead, one is advised to use approximation procedures unless only one or two units of time *(t)* are considered (Götze et al., 2015). Microsoft excel comes with ready IRR approximation formulae that can be used.

The internal return rate *r* is compared to a required return rate, which is often denoted by *k* (Pike & Neale, 2006). To clarify: the decision maker must be able to decide on a value for *k*. No return rate can be automatically assumed as a good or bad rate of return without anything to compare them to. When *k* > *r*, the project should be accepted since the return rate of the investment opportunity at hand exceeds the return rate required by decision maker. The higher the internal return rate the better. If the decision maker needs to select between multiple mutually exclusive projects, the rational choice is the one with the highest internal rate of return.

IRR is among the most commonly used investment appraisal methods (e. g. Alkaraan, 2020; Alkaraan & Northcott, 2006) In a survey covering 150 large manufacturing companies in Finland Huikku et al. (2018) report that 59% of surveyed companies use IRR as one of the key methods used in investment appraisal. The data in this study was gathered during 2008-2011.

2.3.3. Addressing investment risk

Risk refers to "the set of unique consequences for a given decision that can be assigned probabilities, while uncertainty implies that it is not fully possible to identify outcomes or to assign probabilities" (Pike & Neale, 2006 p. 196). From the point of view of investment appraisal, risk can be considered as the chance of making the wrong investment decision, leading to a failure in hitting set targets (Götze et al., 2015).

By gathering and processing information, data can be obtained that helps to reduce uncertainty or help develop understanding on its cause and effects (Götze et al., 2015). In the end investment decisions are only as good as the information they are based on: "Relevant and useful information is central in projecting the degree of risk surrounding future economic events and in selecting the best investment option" (Pike & Neale, 2006 p. 197).

All business information is uncertain on some level, but the "deployment of specific investment appraisal models and methods can be used to determine how changes in company or environmental conditions may cause variations in target measures" (Götze et al., 2015: 247). These models and methods allow the results of investment decisions to be predicted for a range of expectations (Götze et al., 2015). Also, the relative significance of different conditions regarding the firm or its environment can be estimated to determine the value of further information gathering and analysis (Götze et al., 2015). Similarly, the impact of the realization of a risk can be estimated in advance. This might help in mitigation should the risk realise.

In the next chapter the most common methods for investment appraisal in the presence of uncertainty are reviewed.

Risk-adjusted net present value

In the risk-adjusted analysis method the data points in the investment appraisal process are adjusted in an attempt to bolster the results against risk (Götze et al., 2015). Practically this means the tempering of optimism in the economic forecast. This can be accomplished by either risk-adjusting the used discount rates or risk-adjusting the forecasted cash flows (Götze et al., 2015). As we noted earlier, the discount rate used in the net present value formula can include a premium based on the perceived riskiness of the investment project. The discount rate *k* used in the net present value formula includes a margin to account for the assessed level of risk associated with the project (Pike & Neale, 2006).

To account for uncertainty regarding the expected cash flows the expected net present value method can be used. The expected cash flow for each year is obtained by weighing each of the alternative cash flow possibilities with their probabilities of occurrence before calculating the net present value for the investment project. In this formula $\bar{X}$ is the expected value of event X, X_i the possible cashflow outcome from event X, p_i the probability of the outcome X_i and N the number of possible outcomes (Pike & Neale, 2006).

$$\bar{X} = \sum_{i=1}^{N} p_i X_i$$

The formula is used to calculate the expected value of the cash flow in each year and these expected cash flows are used in the net present value formula we saw earlier to calculate the expected net present value of the invest project under consideration. For this method to be used one must be able to assign probabilities to alternative cash flow events.

In survey studies mapping the use of risk-assessment techniques used by managers, risk-adjusting cash flows registers as one of the most widely used methods (e. g. Abdel-Kader & Dugdale, 1998; Alkaraan & Northcott, 2006; Alkaraan, 2020).

Sensitivity analysis

Sensitivity analysis can shed light from two very useful points of view during the investment appraisal process. It is used to answer two kinds of “what if” questions (Götze et al., 2015 p. 259):

1) How does the target value change with given variations of an input measure or of several input measures?
2) Which critical values must an input measure, or a combination of several input measures, achieve to reach a given target value?

An example of the first category would be analysis of what happens to the net present value of the investment project if the initial investment turns out to be 10% larger than expected? Following this line of thinking we can ask an even more profound question in the second category: how much larger than expected can the initial investment turn out to be before the net present value of the investment projects turns from positive to negative?

Sensitivity analysis is a very common tool in investment appraisal projects (Götze et al., 2015; Pike & Neale, 2006). In surveys mapping the use of various methods the sensitivity analysis consistently registers as the most widely used method in assessing the risk of strategic investment projects (e. g. Abdel-Kader & Dugdale, 1998; Alkaraan & Northcott, 2006; Alkaraan, 2020).

A common method when conducting a sensitivity analysis is to plot a sensitivity graph (Götze et al., 2015; Pike & Neale, 2006). A sensitivity graph is made by having a target measure (commonly net present value) on the Y-axis and a deviation expressed as percentages on the X-axis. The lines are plotted by calculating the target measure when an input measure is subjected to a deviation. The higher the derivative or steeper the line corresponding to an input measure, the higher the impact that input measure has on the target measure. This means that changes in this input measure has a more dramatic impact on the target measure than input measures that have a flatter curve or lower derivatives.

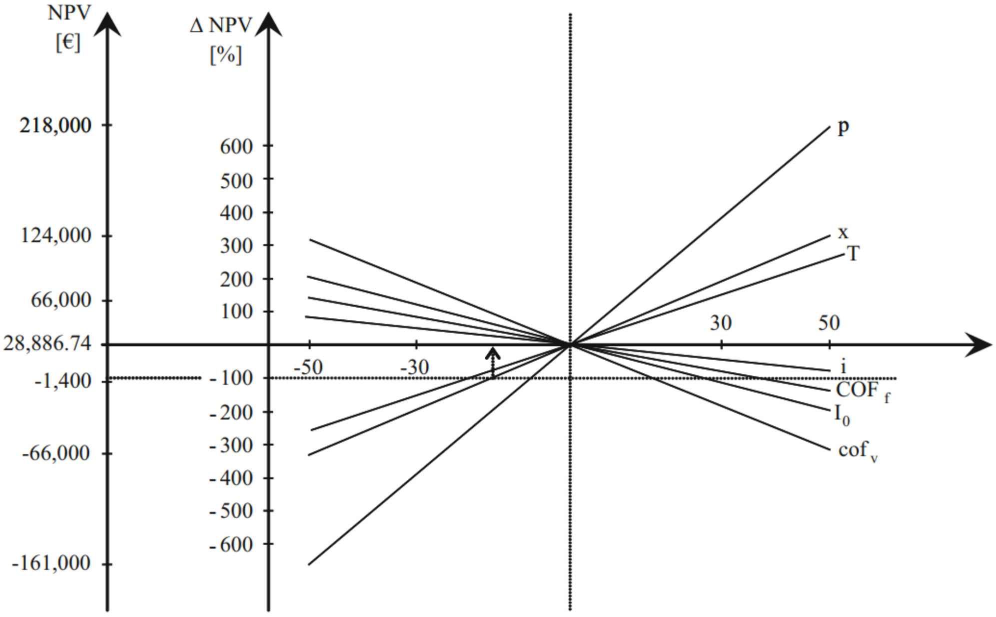

Figure 2. Example of a sensitivity graph, Götze et al., 2015 p. 261. The impact of various input measures on the horizontal axis reflect to different impacts in project NPV expressed on the vertical axis.

Sensitivity analysis can also be used to determine a critical value for each input measure. The critical value is the value for the input measure that causes the investment project to have a net present value of zero (Götze et al., 2015). This critical value can be considered as the minimum acceptable value for the input measure as investment project prospects with a negative net present value should be declined. The decision-maker should be especially interested in the difference between the input measures critical value and the original estimated value and the probability of the input measure deviating enough to reach the critical value (Götze et al., 2015). In the case of positive NPV projects the distance between the estimated value and critical value is the margin of error separating the project from failure, and in the case of negative NPV project the distance represents the required improvement in the input measure in question to make the investment project an acceptable candidate.

In this method only one input measure is analysed at a time and the other input measures remain constant. If more than one input measure is examined simultaneously, the determination of critical value combinations results in a critical surface in the graphical illustration (Götze et al., 2015 p. 262). When two input measures are analysed simultaneously the results can be illustrated as a surface in three-dimensional space. Three input measures would require a four-dimensional illustration and is thus not practical. An example of an illustration of net present value relative to variations in sales prices and volumes in a hypothetical example is below:

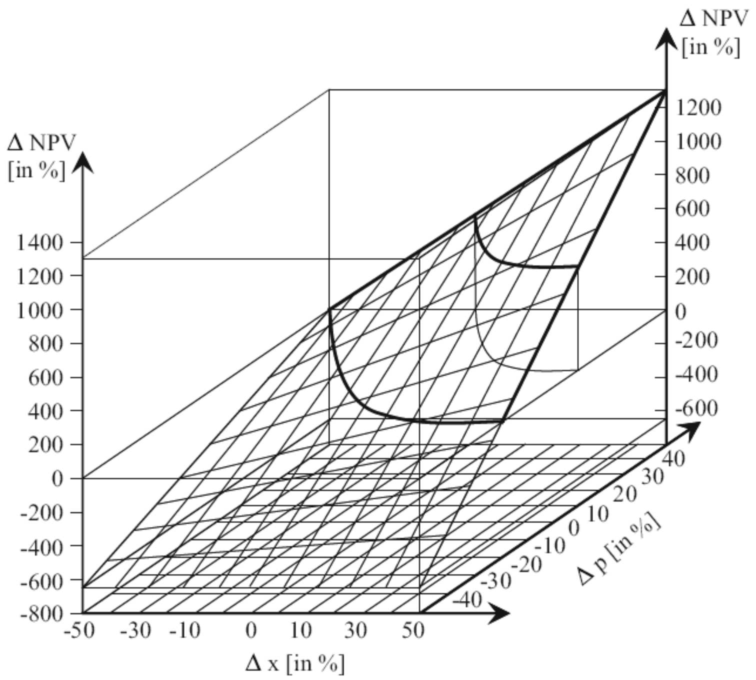

Figure 3. Example illustration of critical surface: net present value relative to variations in sales prices and volumes, Götze et al., 2015 p. 263.

Sensitivity analysis can be used in conjunction with any investment appraisal methods including methods that incorporate risk by adjusting the uniform discount rate or stream of cash flows (Götze et al., 2015). An example of such a method is the expected net present value method briefly described earlier. Sensitivity analysis provides insight into the structure of a model and allows the examination of the effects of uncertain model data and violated assumptions on the model's results (Götze et al., 2015 p. 264). As we already discussed the sensitivity analysis does not contain decision criteria and it is up to the decision-maker to interpret the results and put them to use in the investment appraisal process.

Disadvantages of the approach arise from the assumed constancy of those input measures that are not analysed. In the end there are infinite combinations of input measures and one must choose which combinations are relevant to reach a satisfying coverage with the sensitivity analysis. Blind spots, however, cannot be avoided as a result. It would be theoretically possible to analyse changes in more than two values at a time, but this leads to difficulties interpretation and is very complicated (Götze et al., 2015). From a practical perspective sensitivity analysis explicitly analyses only a few input values and makes no statements about the probability of possible deviations (Götze et al., 2015). While the sensitivity analysis can answer “what if” questions it is best to be paired with a method that can address the probabilities of these “ifs”. This brings us to risk analysis methods.

Risk analysis: simulation and scenario methods

Risk analysis methods described in this chapter function by representing uncertain input measures as probability distributions (Götze et al., 2015; Pike & Neale, 2006). Whereas the sensitivity analysis described previously is limited to the evaluation of a constructed model, risk analysis methods deal with data procurement and model construction (Götze et al., 2015). The risk analysis process follows the following steps (Götze et al., 2015 p. 265).

1) Formulation of a decision model.
2) Determination of the probability distributions for the input measures that are assumed to be uncertain.
3) Inclusion of dependencies between the uncertain input measures.
4) Calculation of a probability distribution for the target measure.
5) Interpretation of the results.

In the first step a model is constructed. This can be based on the NPV method, for example. Next the input measures (sales volume as an example) are considered. Once these input measures are identified probability distributions must be attached to them.

This approach is similar to the risk-adjusted net present value method discussed earlier. Finally, the probability distribution for the target measure, in this case the NPV of the investment project can be calculated, and the results interpreted.

Dependencies where one the outcome of one uncertain input depends on the outcome of another uncertain input can be challenging to include in the analysis due to added complexity (Pike & Neale, 2006). These are known as stochastic dependencies and can be included by using correlation coefficients or conditional probability distributions (Götze et al., 2015). A conditional probability distribution is created by allowing the probability distribution of one input to be varied based on the state of the probability distribution assigned to another input. Naturally, the way two inputs are dependent must be known for this information to be included in the analysis through either of the two methods.

The actual number crunching (step four) can be approached with one of two approaches, which Götze et al. (2015, p: 266) name the analytic or the simulation approach. The analytic approach as described by Götze et al. (2015) works by formulating the investment appraisal project as a single equation that can be solved. While academically appealing this approach is limited in its usefulness in real life applications, because only a small number of input measures can be treated as variables (Götze et al., 2015). The simulation approach does not have this problem. It is also more in line with the spirit of the available data in investment appraisal applications. The used probability distributions and to some extent the data itself will inevitably be subjective in nature (Götze et al., 2015; Pike & Neale, 2006). It does not therefore make sense to sacrifice practicality for mathematical elegance in the target measure calculation step. Simulations allow multiple variables to be considered simultaneously and with enough repetitions simulations yield results that are accurate enough for investment appraisal (Götze et al., 2015).

A simple version of the simulation approach is the use of scenarios. Instead of simulating outcomes across a whole range of a probability distribution, in the scenario approach a small number of key variable states are picked. As an example, consider a situation where sales volume is expected to be 100 units and the sales volume to be normally $X \sim N(\mu, \sigma)$ distributed with a standard deviation of 10. Expressed as a normal distribution this is $X \sim N(100, 10)$ and produces a normal distribution when drawn out (Figure 4)[10].

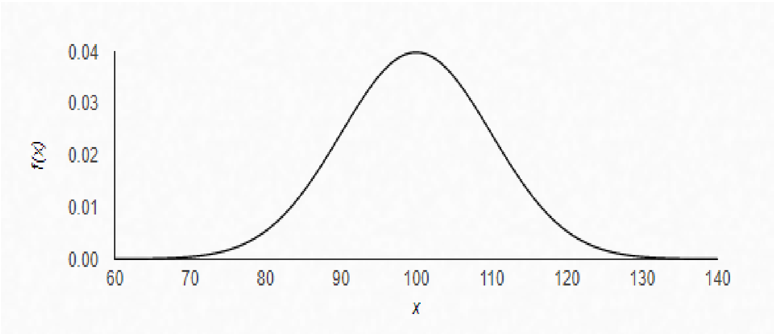

Figure 4. Example of a normal distribution.

Next, the practitioner could generate many versions of the business case associated with this investment project prospect that follow this probability distribution of sales volume. This is called a Monte Carlo simulation (Pike & Neale, 2006). The Monte Carlo method is a statistical approach that can be used to create estimates in situations where completely solving an equation is extremely laborious or obtain or downright unobtainable (Metropolis & Ulam, 1949). By calculating a target measure (often net present value) with a range of input differing input measures following a probability distribution, a probability distribution of target measures is generated. The method "has roots in financial engineering, but has emerged as an important tool for corporate financial analysis because of its benefits in visualizing risk and the ever increasing ease of executing the analysis due to more powerful computers and software packages being available" (Arnold & North, 2011 p. 296).

Whereas the simulation methods cover an entire range of probabilities, in scenario analysis specific data states are picked based on some significance assigned to these

[10] Constructed using online tool at https://homepage.divms.uiowa.edu/~mbognar/applets/normal.html, accessed 28.07.2020

specific values. A common approach is to pick one really good outcome and one really bad outcome. These outcomes are known as the worst and best scenario.

In the example above the worst case could be 60 and the best case 140 units sold. The odds of the sales unit volume realizing as 140 or higher in the $X \sim N(100, 10)$ distribution above is one in 30,000. Therefore, it does not make a lot of sense to pay so much attention to this number from an academic perspective. This approach is definitely "more of an art than science", but it is considered very useful because it encourages contingent thinking (Pike & Neale, 2006 p. 206).

Whereas scenario analysis works by analysing how specific states of variable input measures affect an output measure, in simulations the entire range of considered possibilities in input measure variation are considered. Instead of human selection, randomness following the probability distribution associated with the variation of an input measure is used in the selection of the states of input measures. Every time the simulation is run this randomness will produce different results. The number of runs should be large enough for the randomly generated numbers to be representative of the probability distribution of the input measure(s) that are being simulated (Götze et al., 2015). After many repetitions, the results of the simulation form the probability distribution of the target measure, such as net present value of an investment project.

The results of simulations can be very helpful in the decision-making process in investment appraisal (Götze et al., 2015). The probability distribution of target measures can be organised in formats that are very informative. For example, the figure below of the distribution function of the net present values of two investment projects provides the decision-maker with very useful insights. What the specific numbers are is not important for this illustration.

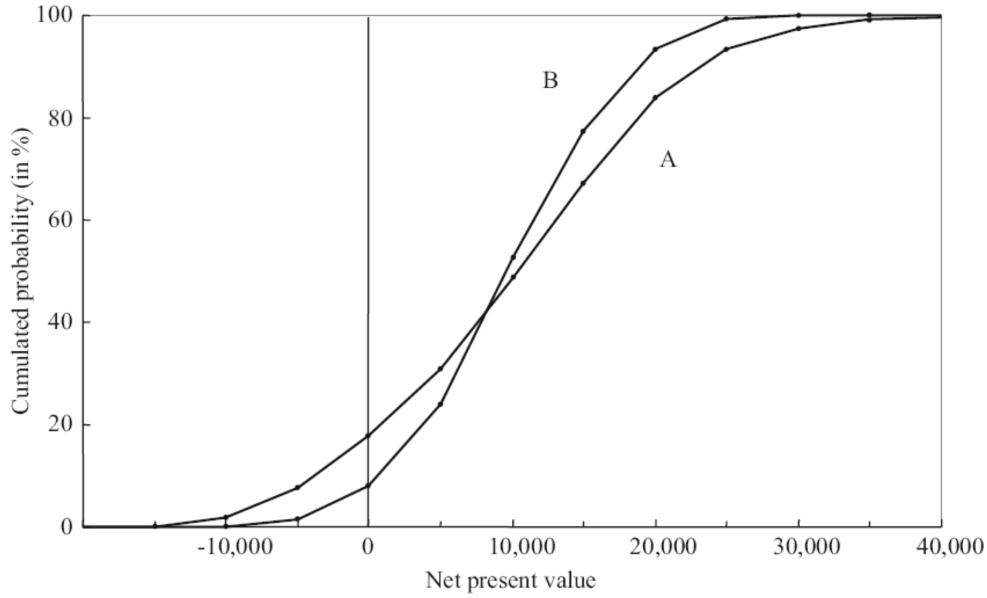

Figure 5. Illustrative example: Distribution function of the net present values of two investment projects (Götze et al., 2015 p. 269).

This figure shows that the chance for project A to be profitable (positive NPV) is roughly 80% and above 90% for project B. In the high end, project A has better odds of being spectacularly successful, having a near 20% chance of having a net present value of more than 20,000. The chance that project B achieves a net present value of more than 20,000 is less than 10%. The expected value for both projects is similar, but the probability distributions of the two projects have important and interesting differences. The decision maker is much more informed after having access to a representation such as this one.

2.3.4. Summary of investment appraisal methods

Investment appraisal is the activity of evaluating the financial aspects of an investment project (Pike & Neale, 2006). The most popular methods used in investment appraisal include the payback period, accounting rate of return, internal rate of return and net present value (e. g. Adler, 2000; Alkaraan & Northcott, 2006). It is recommended that multiple methods are used simultaneously (Götze et al., 2015).

Only data that can be expressed as cash flows can be incorporated into analysis done with these methods. The methods also require the decision-maker to estimate future cash flows, sometimes far into the future. As a result the methods are always based on incomplete and biased information. It is important to understand the magnitude of risks associated with the results. Common and proven ways for estimating risks include scenario analysis, sensitivity analysis and simulation.

3. Methodology

In this section, I explain how constructive case study research methodology reflects my approach to conducting this thesis. I also show why constructive research was a suitable method for this master's thesis and elaborate on the research process.

3.1. Constructive case study research

Constructive research may be viewed as an applied study whose aim is the production of new knowledge in the form of normative applications (Kasanen et al., 1993, p. 252). Practically, this entails the development of novel solutions to real life (business) problems. The approach is normative, as it is targeted at providing recommendations for managerial action, and empirical as the research process is grounded in an empirical case (Kasanen et al., 1993, p. 252).

The purpose of constructive research is to produce a construct that can be used to solve the empirical problem. Here "construct" refers to an artifact, such as a model, diagram, plan, organisational structure, or other creation that solves the problem (Lukka, 2003; Kasanen et al., 1993). Core features of constructive research are that the produced artifact is 1. relevant and functional, 2. is connected to theory and uses theory to build solutions, and 3. makes a theoretical contribution by reflecting empirical findings back to theory (Lukka, 2003). The research process includes an attempt for implementing the developed construction as a test of its applicability and practicality. Close co-operation between the researcher and practitioners is common in constructive research (Lukka, 2003).

This thesis was conducted following the constructive research process outlined in Figure 6 below:

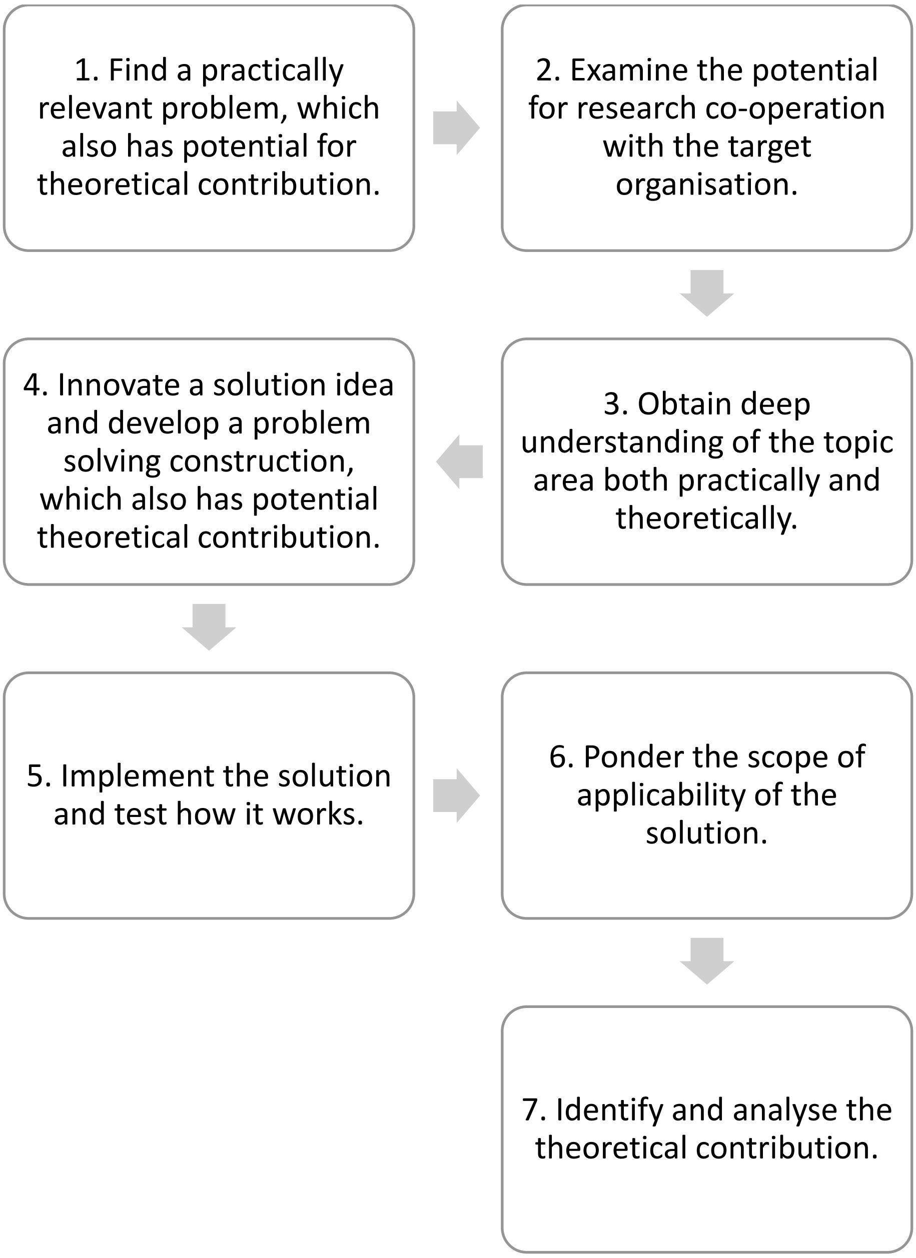

Figure 6. Constructive research process (Lukka, 2003).

Constructive research aims to find a solution that works, which can be considered as evidence of the solutions validity and truthfulness (Lukka, 2003). The epistemology of constructive research is thus: what works in the world is true. Constructive research is pragmatic. This practicality and solution-orientation make constructive research a very suitable method for answering the research questions of this thesis, as the goal of this research is to produce a working solution to a real-life problem.

In the next section I describe the research process from the point of view of the constructive research process according to Lukka (2003).

3.2. Constructive research process and data gathering

Steps 1 and 2. Find a practically relevant problem, which also has potential for theoretical contribution. Examine the potential for research co-operation with the target organisation:

The research process began with a pre-crafted project brief. This brief was centred on analysing the financial viability of Valio investing in a plant-based ingredient processing facility. The task was to analyse the financial and strategic aspects of this investment project based on pre-determined methods.

The project plan and research questions were reframed to accommodate the updated client needs, available empirical data, and my aspirations as the researcher. A decision was made to focus on how investment decisions like this should be taken and what methods should be applied. This moved the previous research question of whether or not the investment project should be realised as secondary. Assessing how such investment decisions should be taken became the new primary research question.

This setting was theoretically interesting. On one hand the scope was very general as it focused on how investment decisions should be made irrespective of the type of manufacturing industry in question. On the other hand, the problem was specific to the client company, which made the problem setting novel from a theoretical perspective.

Step 3. Obtain deep understanding of the topic area both practically and theoretically.

To develop practical understanding, I read Valio’s financial statements and publicly available financial and strategic materials from the years 1994 – 2008, 2015 and 2017 – 2019. I also read the investor materials published by Arla Foods (2019) to better understand dairy industry dynamics. Arla Foods was selected as it shares many aspects of Valio in operating logic, products, and target markets. I also studied information published by Valio on the www.valio.fi website and two articles by Lamprinakis (2012; 2015), which study strategic decision-making and change management at Valio in the past, and conducted one expert interview with a specialist from LUKE (National resource institute of Finland). I remained in weekly contact with the client organisation during the entire research process. This interaction paired with rigorous study of literature and the public archives of Valio provided me with a deep understanding of the topic.

The key insight arising from these readings was that Valio's plant-based business and dairy business differ most in their level of vertical integration, and that the dimension of vertical integration is the most meaningful strategic aspect to assess in this study. The following factors resulted in the drawing of this conclusion:

1. Valio is owned and managed by dairy farmers and its goal is to enable the success of the farmers rather than maximise its profits. This highlights that the operations in the later parts of the value chain are connected to the earlier parts of the value chain.
2. Valio has had recent success in the sales of highly developed dairy ingredients and dairy processing technologies. Valio reports that these are seen as key growth areas (Valio 2019). This hints that the ingredient processing and process development operation are strategically timely and relevant to consider also for plant-based products.
3. Valio has a long history of running a vertically integrated operation and developing the entire value chain. Whether these capabilities are transferable to the plant-based dairy replacement business is important to address when making investment decisions about plant-based ingredient processing.

To gain a deep theoretical understanding I engaged strategic investment decision making literature, as the investment project matched definitions of a strategic investment project (Slagmulder et al., 2015; Alkaraan & Northcott, 2006).

I also studied articles that review and survey the make-or-buy decision making literature: Serrano et al. (2018) and Dibbern et al. (2004). The theoretical and empirical foundations on which this research is built on are found in the introduction and literature review chapters of this thesis.

Step 4. Innovate a solution idea and develop a problem-solving construction, which also has potential theoretical contribution.

After gaining sufficient footing in the topic area the innovative stage of the research process began. It was clear that the solution construct needed at least two components, as the financial and strategic aspects of investment projects should be assessed separately (e. g. Slagmulder et al., 2015; Alkaraan & Northcott, 2006).

For the strategic analysis I had already concluded that the level of vertical integration would be the most important dimension to cover. Therefore, the investment project was best to be evaluated as a make-or-buy decision, as this viewpoint directly assesses the strategically desirable level of vertical integration. I chose to focus on the most popular theories found in literature covering the making of make-or-buy decisions and thus decided to focus on the resource-based view (RBV) and transaction cost economics (TCE) (Serrano et al., 2018; Dibbern et al., 2004).

To bring these theories together, I constructed a decision-making framework. The construct was inspired and heavily based on McIvor's (2009) who developed a TCE-RBV framework to be used in outsourcing decision-making. The created make-or-buy decision making construct captures the strategic aspects of the investment project and proved useful in initial testing. I consider the construct adequate as a method of strategic analysis in this case, as it is firmly anchored in make-or-buy decision literature, and because a similar construct or framework has been deployed earlier (McIvor, 2009; Brewer et al., 2013).

For the analysis of financial matters, a cash-flow based Excel model was established. This was a very participatory process as the client was greatly involved in selecting what aspects of the investment project should be included in the model. As the researcher I made sure that the data is sufficient for the use of the most important investment appraisal methods I found during my review of the investment appraisal literature. The origin and time of gathering of this data is shown in Table 2 below.

The background, associated assumptions, and limitations of the most widely used investment appraisal methods were compiled in the literature review section 2.3. This section leans heavily on two finance textbooks: Götze et al. (2015) and Pike & Neale (2006). This does not compromise the academic rigor of the section as the subjects discussed are not particularly contested based on my understanding of the relevant literature. For example, the way in which net present value is to be calculated and the assumptions associated with the method do not appear to be contentious issues.

The most important insight during this stage was that rather than assessing the viability of a single investment project, the client needed a method to analyse different variations of investment projects. For example, the ability to generate understanding of the required price for a process output for the project to be financially viable was more important than assessing whether the project is viable when the process output is priced at X or Y euros. This led to further development of the Excel model and the inclusion of features, which enable and encourage scenario-analysis.

The construct for assessing financial matters of the investment project is described in chapter 4.1.1: Constructed Excel model.

Data	Page	Origin	Time of gathering
Production process steps	49	Valio R&D	06/2020
Production process outputs	49	Valio R&D	05/2020
Process quantity tables	50-52	Valio R&D	06/2020
Production output quantities	53	Valio R&D	07/2020
Production input quantities	50-53	Valio R&D, EU BAT 2019[11]	07/2020

[11] Santonja et al., (2019), Best Available Technologies EU

Price data	55	Valio R&D, stat.fi, chembid.com	06-07/2020
Initial investment estimate	56	Valio R&D	08/2020
Required rate of return	56	Valio R&D	08/2020

Table 2. Origins of data used in financial analysis.

The construct is documented in enough detail to allow for reproduction and potential use in other firms or even industries.

Steps 5-7. Implement the solution and test how it works. Ponder the scope of applicability of the solution. Identify and analyse the theoretical contribution.

With the two lenses (financial and strategic) complete the research question could now be answered by implementing the created construct. The implementation was carried out by introducing the construct to a wider client audience. The use of the construct was instructed and written, and video format instruction were created to enable the continued use of the construct. The assessment of the practical value of the construct is based on data gathered from informants listed in Table 3 below. This data was gathered in an online feedback session on the 15th of September, 2020.

Person	Role
A	Technology manager, Valio
B	Process specialist, Valio
C	Investment planning manager, Valio

Table 3. List of informants used to assess practical validity.

The implementation was successful as both the strategic and financial aspects of the investment project could be assessed, and managerial recommendations provided. The client also demonstrated satisfaction toward the construct and was able to use it in the intended manner. The implementation is described in length in chapter 4: Results. The theoretical and practical contribution and scope of applicability of this research are discussed in chapter 5. The limitations of this study are assessed in chapter 5.2: Limitations and further research.

4. Results

In this thesis a strategic investment decision-making construct is constructed. This construct consists of financial (numerical) and strategic (non-numerical) perspectives and these two perspectives are assessed separately. This thesis presents the client, Valio a tool that can be used in strategic investment decision making. This thesis also aims to provide recommendations by applying the proposed decision-making construct to data that could be accessed and used during the research process.

In this results chapter this tool and its use is demonstrated using the best data set that could be accessed. The recommendations provided reflect the quality of this data set and the primary purpose of this section is to demonstrate the use and qualities of the created tool, while implications of the provided results should be considered only secondarily.

That being said the Chapter 4.1 Financial analysis and chapter 4.2 Strategic analysis form the two halves of the answers to the research questions by providing the financial and strategic insight necessary to evaluate the viability of the investment project.

These research questions are:

> *RQ1:* How should the decision of investing in a plant-based ingredient processing facility at Valio be taken according to recent make-or-buy decision and strategic investment decision making literature?
>
> *RQ2:* Should Valio invest in a plant-based ingredient processing facility based on the data that could be gathered?

The decision of investing in a plant-based ingredient processing at Valio should be taken by applying the decision-making framework presented in Figure 7 below. This framework includes separate lenses for the analysis of strategic and financial aspects of the investment project. The strategic aspects are analysed through a make-or-buy decision framework, while the financial aspects and risk are analysed through numeric investment appraisal methods.

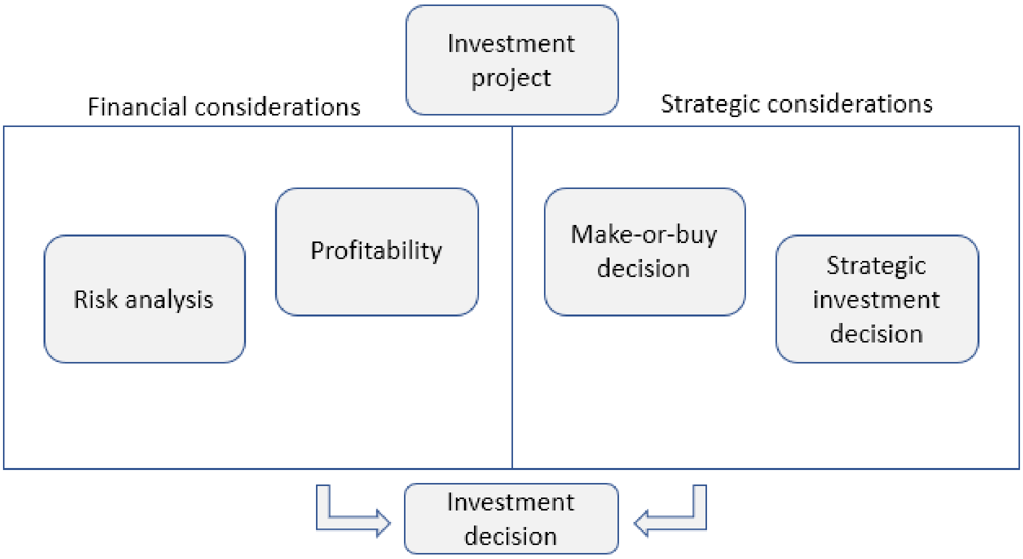

Figure 7. Developed investment decision-making framework.

4.1. Financial analysis

The primary contribution of this thesis is an analytical quantitative tool that can be used to analyse the financial performance of a plant-based ingredient processing facility using multiple settings. In this section this cash flow centric tool and its use are described and demonstrated using a data set. The investment appraisal methods introduced in the literature review are then applied to the data and the results interpreted.

This forms the first half of the answer to the research questions.

4.1.1. Constructed Excel model

The constructed model acknowledges the production of four outputs using four corresponding core inputs (Table 4):

Process output	Corresponding core input
Oat protein concentrate	Oat flour
Pea protein isolate	Pea flour
Faba bean protein isolate, 84% protein	Faba bean flour

Table 4. modelled process outputs.

The production process is modelled as follows (Figure 8):

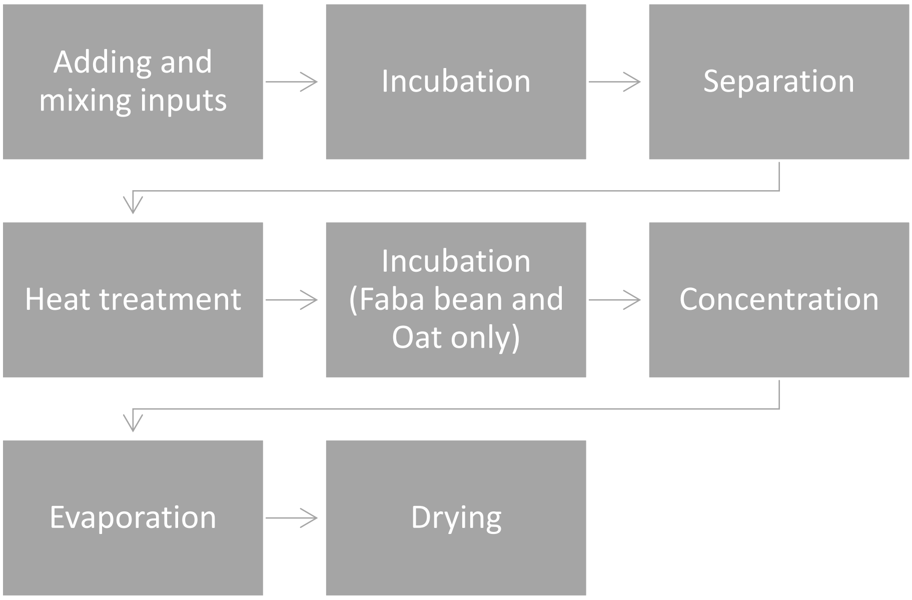

Figure 8. Process model.

Quantities of process inputs and outputs are inserted comparatively to the amount of the core ingredient. The following process input and output quantity sheets (Table 5 - Table 7) contain the process input and output quantity data used in this thesis. This data is provided by the client.

	Required process inputs	Input amount as % of Oat flour	Process outputs	Output amount as % of Oat flour
Mix inputs				
	Oat flour	100.00%		
	Additives	2.10%		
	Water	394.55%		
Incubation				
	Solutions to adjust pH (15% NaOH)	3.25%		
Incubation 2			499.90%	
Separation				
			Waste	87.50%
			Not waste	412.40%
High temperature treatment				
Concentration				
	Water	700.00%	Waste	956.40%
			Waste 2	1.50%
			Concentrate	156.00%
Evaporation				
			Evaporated water	76.57%
			Concentrated concentrate	77.93%
Drying				
			Evaporated water	57.39%
			Waste	0.96%
			Oat protein concentrate	**19.58%**

Table 5. Process quantity table, Oat protein concentrate.

	Required process inputs	Input amount as % of Pea flour	Process outputs	Output amount as % of Pea flour
Mix inputs				
	Pea flour	100.00%		
	Water	564.00%		
	Solutions to adjust pH (15% NaOH)	2.67%		
Incubation			666.67%	
Separation				
			Waste	126.67%
			Not waste	540.00%
High temperature treatment				
Concentration				
	Water	1000.00%	Waste	1386.67%
			Waste 2	1.50%
			Concentrate	153.33%
Evaporation				
			Evaporated water	40.89%
			Concentrated concentrate	110.94%
Drying				
			Evaporated water	93.86%
			Waste	2%
			Pea protein isolate	**15.08%**

Table 6. Process quantity table, Pea protein isolate.

	Required process inputs	Input amount as % of Faba Bean flour	Process outputs	Output amount as % of Faba Bean flour
Mix inputs				
	Faba Bean flour	100.00%		
	Water	1147.38%		
	Additive 1	1.25%		
	Additive 2	0.25%		
	Solutions to adjust pH (15% NaOH)	1.13%		
Incubation			1250.00%	
Separation				
			Waste	143.75%
			Not waste	1106.25%
Incubation 2				
	Additive 3	1.25%		
High temperature treatment				
Concentration				
	Water	1900.00%	Waste	2690.00%
			Waste 2	1.50%
			Concentrate	317.50%
Evaporation				
			Evaporated water	84.68%
			Concentrated concentrate	231.32%
Drying				
			Evaporated water	195.99%
			Waste	2%
			84% Faba bean protein isolate	**33.33%**

Table 7. Process quantity table, Faba bean isolate 84% protein content.

These process parameters together with the price data of inputs and outputs forms the basis of the model. These values can be changed and for some key parameters a specific interface for the changing of values was added.

Production quantities

For production quantities a scenario list approach was selected (Table 8). Three production scenarios were created with different production mixes. In the demonstration of the model the "Oat heavy" production mix is used. The total production is set at 500,000kg output per year as initial full-scale production volumes for all scenarios.

Production per year (kg)	Oat heavy	Balanced	Faba heavy
Oat	350,000	200,000	100,000
Faba Bean	100,000	150,000	300,000
Pea	50,000	150,000	100,000
Total	500,000	500,000	500,000

Table 8. Production scenarios.

Finally, the following process parameters listed in Table 9 below could be established and were thus included in the model. The energy consumption of those processes whose energy requirement as a function of processed quantities could be determined are included in the model. Other energy requirements such factory heating, logistics or control systems are not included in the model.

Input amounts	Value	Unit of measurement	Source / link
Cleaning in place chemicals			
HNO3	0.004	kg/kg produced	Santonja et al., (2019), Best Available Techniques EU
NaOH	0.004	kg/kg produced	Santonja et al., (2019), Best Available Techniques EU
Other			
Personnel	6	Work years/year	Client estimate
Process water	3	kg/kg of process input	Client estimate

Energy requirements	Value	Unit of measurement	Source / link
Separator	0.0024	MJ/kg feed	Client estimate
Evaporator	0.8	MJ/kg water removed	Client estimate
Spray dryer	4	MJ/kg water removed	Client estimate
Concentrator	10	MJ/m3 feed	Client estimate

Table 9. CIP-chemical, labour, process water and energy quantity need of the modelled operation.

Inserting price data into the model

The model is intended as a tool that can be used to assess the impact different datapoint inputs have on the investment project profitability. To facilitate this an interface (Figure 9) was added to enable the changing and experimenting between alternative values for price data. The selection can be applied for each row separately by inserting the value "1" into the designated cell or by changing the selection of the "pick for unspecified" option. If only one value is inserted, it should be placed in the "Mid" category as the model will look for a value in the "Mid" cell if the "Low" cell of the row is empty.

Price data				Pick for unspecified:		Mid	
Item	Picked value	Low	Mid	High	Low	Low Mid High	High
Oat flour	€ 0.60	1			€ 0.60		1.50
Additives	€ -						
Water, litre	€ 0.0015				€ -	€ 0.0015	€ -
15% NaOH	€ 0.30				€ -	€ 0.30	€ -
Oat protein concentrate	€ 15.00				€ 10.00	€ 15.00	€ 20.00

Figure 9. Interface for selecting values used by the model from a determined range.

A section to add forecasted annual price change information as percentages was also added (Figure 10) as the ability to simulate these price changes over longer time periods can alter the viability of the investment project drastically. The price change/y functionality was initially added to only some of the rows. Conditional formatting and icon sets were used to clarify this functionality. Only those cells in the "Price change/y" column, which have a light-yellow background can be added price change information to. If a value is added to another cell a red cross symbol is produced to notify the user of the error. Simple arrows were added to the appropriate cells to highlight whether a price increase or decrease datapoint is inserted.

Price data				Pick for unspecified:		Mid		
Item	Picked value	Low	Mid	High	Low	Mid	High	Price change/y
Oat flour	€ 0.80				€ 0.60	€ 0.80	€ 1.50	0%
Additives	€ -							
Water, litre	€ 0.0015				€ -	€ 0.0015	€ -	
15% NaOH	€ 0.30				€ -	€ 0.30	€ -	
Oat protein concentrate	€ 15.00				€ 10.00	€ 15.00	€ 20.00	0%
Faba Bean protein flour	€ 1.90				€ 1.71	€ 1.90	€ 2.09	
Faba Bean flour	€ 1.10				€ 0.99	€ 1.10	€ 1.21	
Pea flour	€ 0.80				€ 0.72	€ 0.80	€ 0.88	
Additive 1	€ 1.50	1			€ 1.50	€ 2.64	€ -	
Additive 2	€ 1.50			1	€ 1.00	€ 1.40	€ 1.50	
Additive 3	€ 25.50				€ -	€ 25.50	€ -	
Solutions to adjust pH (15% NaOH)	€ 0.30				€ -	€ 0.30	€ -	
84% Faba bean protein isolate	€ 9.00				€ 8.10	€ 9.00	€ 9.90	0%
Pea protein isolate	€ 6.00				€ 5.40	€ 6.00	€ 6.60	0%
Waste water treatment per litre	€ 0.0020				€ -	€ 0.0020	€ -	
One factory work year	€ 45,000.00				€ -	€ 45,000	€ -	0%
Energy, MJ	€ 0.019				€ -	€ 0.019	€ -	
HNO3	€ 0.35				€ -	€ 0.35	€ -	
NaOH	€ 0.35				€ -	€ 0.35	€ -	

Figure 10. Functionalities of the price data interface: picking from a range of values and inserting expected price change data.

Price data used in model demonstration

Above it is shown how the quantities of process inputs and outputs are determined and how price data can be inserted into the model. The price data used in this demonstration and the origin of each of these data points is shown in Table 10 below:

Price data		
Item	Picked value	Source
Oat flour	€ 0.80	Client estimate
Additives	€ -	
Water, litre	€ 0.0015	Client estimate
15% NaOH	€ 0.30	Client estimate
Oat protein concentrate	€ 15.00	Client estimate
Faba Bean protein flour	€ 1.90	Client estimate
Faba Bean flour	€ 1.10	Client estimate
Pea flour	€ 0.80	Client estimate
Additive 1	€ 1.50	Client estimate
Additive 2	€ 1.50	Client estimate
Additive 3	€ 25.50	Client estimate
Solutions to adjust pH (15% NaOH)	€ 0.30	Client estimate
84% Faba bean protein isolate	€ 9.00	Client estimate
Pea protein isolate	€ 6.00	Client estimate
Waste water treatment per litre	€ 0.0020	Client estimate
One factory work year	€ 45,000.00	Client estimate
Energy, MJ	€ 0.019	stat.fi/2018
HNO3	€ 0.35	chembid.com / nitric acid
NaOH	€ 0.35	chembid.com / sodium hydroxide

Table 10. Price data used in model demonstration.

Cash flow logic of model

The economic model is a cash flow expression that calculates the quantities of process inputs and outputs with the data and process information shown above. The model is intended to as a tool for testing how different parameters affect the financial viability of the investment project. A panel for the inserting of five crucial inputs and the selecting of two values from drop down lists was added, as it was seen important for the use of the model to have quick and easily understood way to change these values (Figure 11).

This selection among the production scenarios is done from drop down lists in the main sheet of the excel tool. Other main datapoints inserted in the main input section are the expected life cycle of the factory, estimated time for factory scale up, expected annual volume growth, expected initial investment required and a required rate of return to be used applied in present value calculations.

Initial investment occurs in its entirety during year zero. Production starts at year one and is scaled up linearly over the number of years set by user. Here the scale up time is set to two years. The factory produces 50% of its full-scale volume in year one and 100% in year two. For years following the initial scale up the production volume increases according to the volume year-to-year growth percentage set by the user.

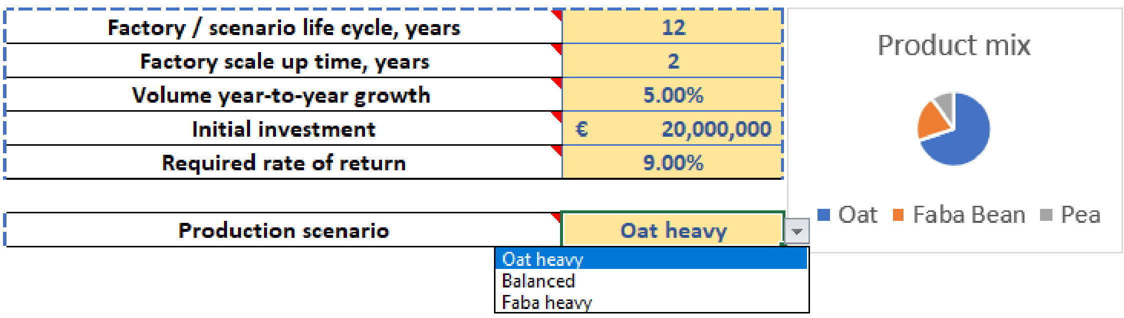

Figure 11. Main panel for inserting key metrics and selecting production scenario.

The model responds to the expected life cycle set by the user by greying out not included years and setting the gross profit for these years to zero. Below are two examples of a 5-year (Table 11) and 10-year (Table 12) expected life cycles in the model. The model is initially limited to assess a maximum investment project life cycle of 20 years.

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11
Revenue	€ 3,225,000	€ 6,450,000	€ 6,772,500	€ 7,111,125	€ 7,466,681	€ 7,840,015	€ 8,232,016	€ 8,643,617	€ 9,075,798	€ 9,529,588	€ 10,006,067
Oat protein concentrate	€ 2,625,000	€ 5,250,000	€ 5,512,500	€ 5,788,125	€ 6,077,531	€ 6,381,408	€ 6,700,478	€ 7,035,502	€ 7,387,277	€ 7,756,641	€ 8,144,473
Volume, kg	175,000	350,000	367,500	385,875	405,169	425,427	446,699	469,033	492,485	517,109	542,965
84% Faba bean protein isolate	€ 450,000	€ 900,000	€ 945,000	€ 992,250	€ 1,041,863	€ 1,093,956	€ 1,148,653	€ 1,206,086	€ 1,266,390	€ 1,329,710	€ 1,396,195
Volume, kg	50,000	100,000	105,000	110,250	115,763	121,551	127,628	134,010	140,710	147,746	155,133
Pea protein isolate	€ 150,000	€ 300,000	€ 315,000	€ 330,750	€ 347,288	€ 364,652	€ 382,884	€ 402,029	€ 422,130	€ 443,237	€ 465,398
Volume, kg	25,000	50,000	52,500	55,125	57,881	60,775	63,814	67,005	70,355	73,873	77,566
Direct material costs	€ 2,245,238	€ 4,396,631	€ 4,522,851	€ 4,655,616	€ 4,795,254	€ 4,942,105	€ 5,096,532	€ 5,258,912	€ 5,429,642	€ 5,609,139	€ 5,797,840
Other variable costs	€ 468,456	€ 666,912	€ 686,757	€ 707,595	€ 729,475	€ 752,448	€ 776,571	€ 801,899	€ 828,494	€ 856,419	€ 885,740
Gross profit	€ 511,306	€ 1,386,458	€ 1,562,892	€ 1,747,914	€ 1,941,953	€ -	€ -	€ -	€ -	€ -	€ -
Gross profit margin	15.85%	21.50%	23.08%	24.58%	26.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Table 11. Model economic life set to five years.

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11
Revenue	€ 3,225,000	€ 6,450,000	€ 6,772,500	€ 7,111,125	€ 7,466,681	€ 7,840,015	€ 8,232,016	€ 8,643,617	€ 9,075,798	€ 9,529,588	€ 10,006,067
Oat protein concentrate	€ 2,625,000	€ 5,250,000	€ 5,512,500	€ 5,788,125	€ 6,077,531	€ 6,381,408	€ 6,700,478	€ 7,035,502	€ 7,387,277	€ 7,756,641	€ 8,144,473
Volume, kg	175,000	350,000	367,500	385,875	405,169	425,427	446,699	469,033	492,485	517,109	542,965
84% Faba bean protein isolate	€ 450,000	€ 900,000	€ 945,000	€ 992,250	€ 1,041,863	€ 1,093,956	€ 1,148,653	€ 1,206,086	€ 1,266,390	€ 1,329,710	€ 1,396,195
Volume, kg	50,000	100,000	105,000	110,250	115,763	121,551	127,628	134,010	140,710	147,746	155,133
Pea protein isolate	€ 150,000	€ 300,000	€ 315,000	€ 330,750	€ 347,288	€ 364,652	€ 382,884	€ 402,029	€ 422,130	€ 443,237	€ 465,398
Volume, kg	25,000	50,000	52,500	55,125	57,881	60,775	63,814	67,005	70,355	73,873	77,566
Direct material costs	€ 2,245,238	€ 4,396,631	€ 4,522,851	€ 4,655,616	€ 4,795,254	€ 4,942,105	€ 5,096,532	€ 5,258,912	€ 5,429,642	€ 5,609,139	€ 5,797,840
Other variable costs	€ 468,456	€ 666,912	€ 686,757	€ 707,595	€ 729,475	€ 752,448	€ 776,571	€ 801,899	€ 828,494	€ 856,419	€ 885,740
Gross profit	€ 511,306	€ 1,386,458	€ 1,562,892	€ 1,747,914	€ 1,941,953	€ 2,145,461	€ 2,358,913	€ 2,582,806	€ 2,817,662	€ 3,064,030	€ -
Gross profit margin	15.85%	21.50%	23.08%	24.58%	26.01%	27.37%	28.66%	29.88%	31.05%	32.15%	0.00%

Table 12. Model economic life set to ten years.

As its basic output the model calculates the total annual revenue and associated variable costs to establish annual gross profit and gross profit margin of the operation (Table 13).

			Year 1	Year 2	Year 3
	2				
	3	**Revenue**	€ 3,225,000	€ 6,450,000	€ 6,772,500
+	13	**Direct material costs**	€ 2,245,238	€ 4,396,631	€ 4,522,851
+	56	**Other variable costs**	€ 468,456	€ 666,912	€ 686,757
+	91	**Gross profit**	€ 511,306	€ 1,386,458	€ 1,562,892
	92	*Gross profit margin*	15.85%	21.50%	23.08%

Table 13. Lowest resolution view of economic model cash flows.

The revenue is calculated separately for the three production outputs: faba bean protein isolate, oat protein concentrate, and pea protein isolate. Yearly volume and price point are displayed for each process output. This is shown in Table 14. Revenue breakdown.

			Year 1	Year 2	Year 3
	2				
	3	**Revenue**	€ 3,225,000	€ 6,450,000	€ 6,772,500
	4	***Oat protein concentrate***	€ 2,625,000	€ 5,250,000	€ 5,512,500
	5	*Volume, kg*	175,000	350,000	367,500
	6	*Price*	€ 15.00	€ 15.00	€ 15.00
−	7	***84% Faba bean protein isolate***	€ 450,000	€ 900,000	€ 945,000
	8	*Volume, kg*	50,000	100,000	105,000
	9	*Price*	€ 9.00	€ 9.00	€ 9.00
−	10	***Pea protein isolate***	€ 150,000	€ 300,000	€ 315,000
	11	*Volume, kg*	25,000	50,000	52,500
	12	*Price*	€ 6.00	€ 6.00	€ 6.00

Table 14. Revenue breakdown.

The direct material costs section can be expanded to view the direct material costs breakdown for each of the process outputs separately (Table 15).

2			Year 1		Year 2		Year 3
13	**Direct material costs**	**€**	**2,245,238**	**€**	**4,396,631**	**€**	**4,522,851**
14	*Oat protein concentrate*	€	*1,883,858*	€	*3,673,871*	€	*3,763,953*
15	*Oat flour*	€	*715,015*	€	*1,430,031*	€	*1,501,532*
16	*Solutions to adjust pH (15% NaOH)*	€	*8,714*	€	*17,428*	€	*18,300*
17	*Water*	€	*5,290*	€	*10,579*	€	*11,108*
18	*Water 2*	€	*9,385*	€	*18,769*	€	*19,708*
19	*Additives*	€	*1,145,455*	€	*2,197,063*	€	*2,213,305*
30	*84% Faba bean protein isolate*	€	*223,575*	€	*447,150*	€	*469,507*
31	*Faba Bean flour*	€	*165,017*	€	*330,033*	€	*346,535*
32	*Solutions to adjust pH (15% NaOH)*	€	*509*	€	*1,017*	€	*1,068*
33	*Water*	€	*2,582*	€	*5,164*	€	*5,422*
34	*Water 2*	€	*4,275*	€	*8,551*	€	*8,978*
35	*Additives*	€	*51,193*	€	*102,385*	€	*107,505*
42	*Pea protein isolate*	€	*137,805*	€	*275,610*	€	*289,390*
43	*Pea flour*	€	*132,591*	€	*265,182*	€	*278,441*
44	*Solutions to adjust pH (15% NaOH)*	€	*1,326*	€	*2,652*	€	*2,784*
45	*Water*	€	*1,402*	€	*2,804*	€	*2,945*
46	*Water 2*	€	*2,486*	€	*4,972*	€	*5,221*

Table 15. Direct material costs breakdown.

The quantities of each of the process inputs can be viewed in addition to their cost contribution. As an illustration below (Table 16) is a view of the quantities as kilograms of direct inputs required in the production of the Pea protein isolate below their cost contributions.

2			Year 1		Year 2		Year 3
42	*Pea protein isolate*	€	*137,805*	€	*275,610*	€	*289,390*
43	*Pea flour*	€	*132,591*	€	*265,182*	€	*278,441*
44	*Solutions to adjust pH (15% NaOH)*	€	*1,326*	€	*2,652*	€	*2,784*
45	*Water*	€	*1,402*	€	*2,804*	€	*2,945*
46	*Water 2*	€	*2,486*	€	*4,972*	€	*5,221*
47	***Quantities, kg***						
48	*Pea flour*		*165,739*		*331,477*		*348,051*
49	*Solutions to adjust pH (15% NaOH)*		*4,420*		*8,839*		*9,281*
50	*Water*		*934,765*		*1,869,531*		*1,963,007*
51	*Water 2*		*1,657,385*		*3,314,771*		*3,480,509*

Table 16. Example of display of input materials in cash flow model.

The profit after direct material costs is calculated and presented for each of the process outputs (Table 17). The profit is calculated by deducting the material costs for each of the outputs from the revenue generated by the outputs.

2			Year 1		Year 2		Year 3
52	**Profit after direct material costs**	**€**	**979,762**	**€**	**2,053,369**	**€**	**2,249,649**
53	*Oat protein concentrate*	€	*741,142*	€	*1,576,129*	€	*1,748,547*
54	*84% Faba bean protein isolate*	€	*226,425*	€	*452,850*	€	*475,493*
55	*Pea protein isolate*	€	*12,195*	€	*24,390*	€	*25,610*

Table 17. Profit after direct material costs for process outputs.

Other variable costs include process water, costs of water treatment, energy, personnel, and CIP (cleaning in place) chemical costs. These costs are displayed as shown in Table 18 and are summed to form the other variable costs line above them. The gross profit for each year is calculated by deducting both the direct material costs and other variable costs from the total revenue. The gross profit margin for each year is calculated as $\left({}^{Gross\ profit_t}\!/_{Revenue_t}\right) \times 100.$

2			Year 1		Year 2		Year 3
3	**Revenue**	**€**	**3,225,000**	**€**	**6,450,000**	**€**	**6,772,500**
13	**Direct material costs**	**€**	**2,245,238**	**€**	**4,396,631**	**€**	**4,522,851**
56	**Other variable costs**	**€**	***468,456***	**€**	***666,912***	**€**	***686,757***
57	*Process water*	€	*33,516*	€	*67,033*	€	*70,384*
58	*Water treatment*	€	*74,488*	€	*148,976*	€	*156,425*
59	*Process energy*	€	*89,751*	€	*179,503*	€	*188,478*
84	*Personnel costs*	€	*270,000*	€	*270,000*	€	*270,000*
85	*CIP Chemical costs*	€	*700*	€	*1,400*	€	*1,470*
91	**Gross profit**	**€**	**511,306**	**€**	**1,386,458**	**€**	**1,562,892**
92	*Gross profit margin*		*15.85%*		*21.50%*		*23.08%*

Table 18. Other variable costs low resolution breakdown.

Similar to the direct material costs, all material quantities can be displayed for the other variable costs. The other variable costs are also allocated for each of the process outputs separately. As an example, below (Table 19) are the quantities of process water, water in need of treatment and energy required for the pea protein isolate process along the costs associated with all these quantities.

2			Year 1		Year 2		Year 3
76	Pea process water, water treatment and energy costs	€	29,530	€	59,060	€	62,013
77	*Process water*	€	*4,972*	€	*9,944*	€	*10,442*
78	*Water treatment*	€	*11,231*	€	*22,462*	€	*23,585*
79	*Energy*	€	*13,327*	€	*26,654*	€	*27,987*
80	***Quantities, kg***						
81	*Process water*		*3,314,771*		*6,629,541*		*6,961,018*
82	*Water in need of treatment*		*5,615,498*		*11,230,995*		*11,792,545*
83	*Energy*		*685,392*		*1,370,784*		*1,439,323*

Table 19. Quantities of process water, water in need of treatment and energy required for the pea protein isolate process.

4.1.2. Empirical financial results

The primary intended use of the model is to evaluate the impact of alternative input datapoints on the financial viability of the investment project considering those parameters that are included in the economic model. For this purpose a dashboard on which key investment appraisal metrics are calculated was added. This dashboard includes the most commonly used investment appraisal methods: the payback period, return on investment (ROI), accounting rate of return (ARR), net present value (NPV) and internal rate of return (IRR) (e. g. Alkaraan 2020; Huikku et al. 2018). Along these metrics the average profit margin, cumulative profit and not discounted net value generated by the investment project is displayed.

The results of the model demonstration when the data shown above is inserted to the model are gathered in the investment appraisal dashboard shown in Table 20 below. These values are the primary output and insight generated by the model.

Net Present Value (NPV)	-€ 5,633,974
Payback period in years	9.96
Internal rate of return (IRR)	4.06%
Accounting rate of return (ARR)	11.26%
Return on Investment (ROI)	135.18%
Average profit margin during life cycle	27.29%
Life cycle cumulative profit	€ 27,035,518
Net value	€ 7,035,518

Table 20. Model demonstration results.

Conditional formatting is used to highlight whether the NPV of the investment project in the configuration in which its datapoints are inserted into the model is negative or positive. The internal return rate (IRR) of the project is compared to the required return rate set by the user and flagged as green when the required return rate is exceeded and red when not. For the other measures, the results must be interpreted by the user, as it cannot be simply evaluated whether a payback period of X or Y should be considered a good or bad value (e. g. Götze et al., 2015).

The NPV of this project is negative, which indicates that this project should not be accepted. The payback period is 9.96 years. As an internal rate of return 4.06% can be considered moderately appealing given that Valio's asset base has grown at an average annual rate of 1.8% over the past 15 years (Valio, 2005; 2020). However, the set target return rate is 9% which this project does not reach in the demonstrated state. The required rate of return of 9% sets the bar too high for this project to be accepted. This rate indicates that the investment project is considered relatively risky, given that interest rates and cost of capital are very low currently[12].

4.1.3. Sensitivity analysis

In order to develop further understanding of this investment project a sensitivity analysis was conducted. As the NPV is considered one of the best and most widely used investment appraisal methods, this sensitivity analysis will be conducted by addressing the impact the change of key variables on the NPV of the investment project. As a first step key variables to be included in the analysis are identified. For this project these are listed in Table 21.

Factory / scenario life cycle, years
Initial investment
Required rate of return
Oat flour
Oat flour protein concentrate 50%
Faba Bean flour
Pea flour
84% Faba Bean flour protein isolate

Table 21. Sensitivity analysis parameters.

To conduct the sensitivity analysis alternative values for these variables are assigned and charted. In this

[12] https://www.euribor-rates.eu/en/current-euribor-rates/, accessed 29.07.2020

case deviations of -10% and +10% of the expected value are considered. The net present value is then calculated for each of 27 scenarios. For the scenario life cycle results were rounded to full years because the model is not able to assess other units of time than full years. Instead of 10.8, 12, and 13.2 years 11, 12, and 13 years are used. For interpreting the results this means that the set life cycle might have a slightly higher impact on the NPV of the project than represented in the results. The NPV corresponding to each input measure is calculated and listed in a table as shown in Figure 12 below.

	-10%	0%	+10%	NPV -10%	NPV 0%	NPV +10%
Factory / scenario life cycle, years	11	12	13	- 6,911,637 €	- 5,633,974 €	- 4,369,016 €
Initial investment	€ 18,000,000	20,000,000 €	22,000,000 €	- 3,633,974 €	- 5,633,974 €	- 7,633,974 €
Required rate of return	8.1%	9.0%	9.9%	- 4,784,727 €	- 5,633,974 €	- 6,419,576 €
Oat flour	€ 0.72	€ 0.80	€ 0.88	- 4,462,440 €	- 5,633,974 €	- 6,805,508 €
Oat flour protein concentrate 50%	€ 13.50	€ 15.00	€ 16.50	- 9,934,968 €	- 5,633,974 €	- 1,332,980 €
Faba Bean flour	€ 0.99	€ 1.10	€ 1.21	- 5,363,599 €	- 5,633,974 €	- 5,904,349 €
Pea flour	€ 0.72	€ 0.80	€ 0.88	- 5,416,728 €	- 5,633,974 €	- 5,851,221 €
84% Faba Bean flour protein isolate	€ 8.10	€ 9.00	€ 9.90	- 6,371,287 €	- 5,633,974 €	- 4,896,661 €

Figure 12. Tables containing the input values and corresponding NPV values to be used in sensitivity analysis.

Table 22 shows the positive and negative change of investment project NPV resulting from the change of each input measure. Conditional formatting in excel was used to make these results easier to read.

	ΔNPV		
	NPV -10%	NPV 0%	NPV +10%
Factory / scenario life cycle, years	- 1,277,663 €	-	1,264,959 €
Initial investment	2,000,000 €	-	- 2,000,000 €
Required rate of return	849,247 €	-	- 785,602 €
Oat flour	1,171,534 €	-	- 1,171,534 €
Oat flour protein concentrate 50%	- 4,300,994 €	-	4,300,994 €
Faba Bean flour	270,375 €	-	- 270,375 €
Pea flour	217,247 €	-	- 217,247 €
84% Faba Bean flour protein isolate	- 737,313 €	-	737,313 €

Table 22. Change in project NPV caused by -10% and +10% deviations in selected key input measures.

This data can also be expressed as a sensitivity graph as illustrated in Figure 13 below by representing the data as a line chart.

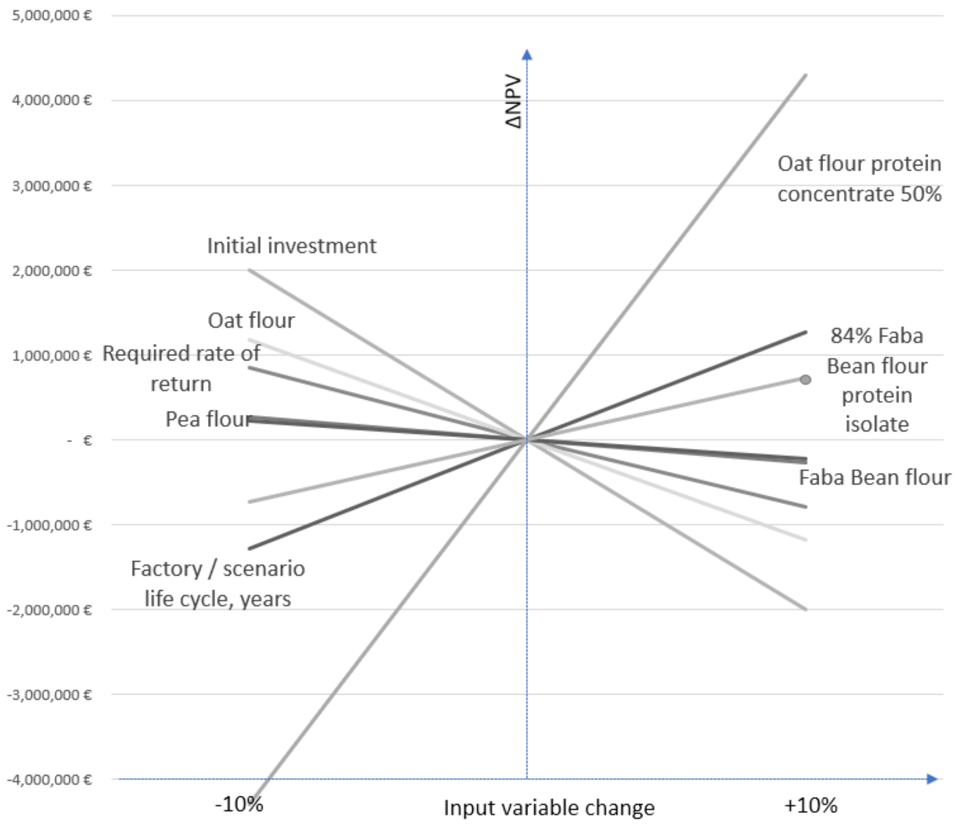

Figure 13. Sensitivity graph representing 10% negative and positive alteration from expected values in investment project economic model.

The steepness of the curve associated with a variable signifies its significance as a contributor to change in NPV. The most impactful variable in this analysis is the main process output: Oat flour protein concentrate, followed by initial investment required and expected factory life cycle. The expected factory life cycle might have a slightly larger impact than represented. In this production scenario the impact of pea and faba bean-based inputs and outputs are relatively small, as the oat process is responsible for 70% of the total mass produced in the factory operation.

It is also possible to use sensitivity analysis to analyse the combined effect the simultaneous deviations of two input measures. We can conclude from the sensitivity graph that the highest impact input measures are the price of the Oat flour protein concentrate 50% (Oat process output) and the initial investment. It would be valuable to better understand what would happen to the NPV of the investment projects if deviations occur in both these measures. To do this a sensitivity surface can be plotted. First a NPV table (shown in Table 23 below) is populated by calculating the project NPV in the following circumstances:

Project NPV		Initial investment		
		€ 18,000,000	20,000,000 €	22,000,000 €
Oat flour protein concentr ate 50%	€ 13.50	- 7,934,968 €	- 9,934,968 €	-11,934,968 €
	€ 15.00	- 3,633,974 €	- 5,633,974 €	- 7,633,974 €
	€ 16.50	667,020 €	- 1,332,980 €	- 3,332,980 €

Table 23. Investment project NPV in simultaneous -10% to +10% deviation of two input measures.

Using these NPV results a sensitivity surface (Figure 14) can now be drawn.

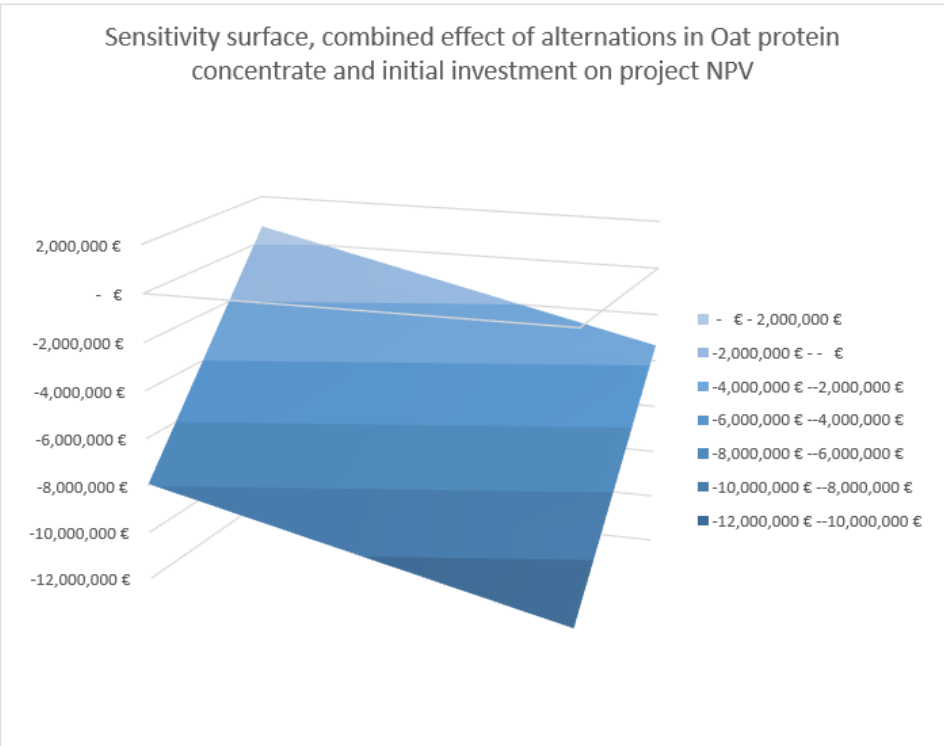

Figure 14. Sensitivity surface of investment project on the impact of -10% to +10% deviations of two high impact input measures.

From this surface it can be concluded that one corner of the surface area (lightest blue colour) is above the zero line. This means that if a -10% to +10% deviation of these two input measures from the expected values can be expected there is a chance for the investment project to yield a positive net present value and thus be considered an acceptable investment project. However, the overwhelming result in the light of this sensitivity analysis is that this investment project does not entail returns that would justify the risks associated with it. While there is a glimmer of hope for the project to reach the required rate of return there is a greater chance for the project to realise at a massively negative NPV.

4.1.4. Critical value analysis

The value of an input measure that causes the investment project to have a NPV of zero (Götze et al., 2015). The purpose of calculating critical values for input measures is similar to the rationale behind the sensitivity analysis. The critical value helps the decision maker to understand how wide the margin for error is in the case of projects with positive NPV and how much improvement in the input measure is needed for the project to reach a positive NPV in the case of projects with negative NPV (Götze et al., 2015).

A critical value analysis was conducted to the input measures listed in Table 24. Whereas in the sensitivity analysis also the Faba bean flour and Pea flour ingredients were included, in the critical value analysis these were not included as there is no value for these input measures that would result in the project attaining a NPV of zero or higher. This is a result of the relatively small weight these ingredients have in the total cost structure of the investment project in the settings used in the demonstration. As a new measure the volume year-to-year growth was added.

Factory / scenario life cycle, years
Initial investment
Required rate of return
Oat flour
Oat flour protein concentrate 50%
Volume year-to-year growth
84% Faba Bean flour protein isolate

Table 24. Input measures for which critical values were calculated.

For each of these input measures the critical value was estimated using the excel Solver tool. A table was then created with the input measure base value, critical value, the difference between the base value and the critical value and the absolute proportional difference between the difference between the values and the original value. The purpose of this last value is to provide understanding of how much each input measure would need be improved for the project to reach an NPV of zero. These values are listed in Table 25.

	Base value	Critical value	Difference Δ	ABS Difference Δ%
Factory / scenario life cycle, years	12	17	5	41.7%
Initial investment	20,000,000 €	14,366,020 €	- 5,633,980 €	28.2%
Required rate of return	9.0%	4.06%	-4.94%	54.9%
Oat flour	€ 0.80	€ 0.42	-€ 0.38	47.5%
Oat flour protein concentrate 50%	€ 15.00	€ 16.96	€ 1.96	13.1%
Volume year-to-year growth	5.0%	11.33%	6.33%	126.6%
84% Faba Bean flour protein isolate	€ 9.00	€ 15.88	€ 6.88	76.4%

Table 25. Results of critical value analysis.

To make this data easier to grasp and apply in decision making the values in the rightmost column were organised from smallest to largest and drawn as a bar chart shown in Figure 15 below.

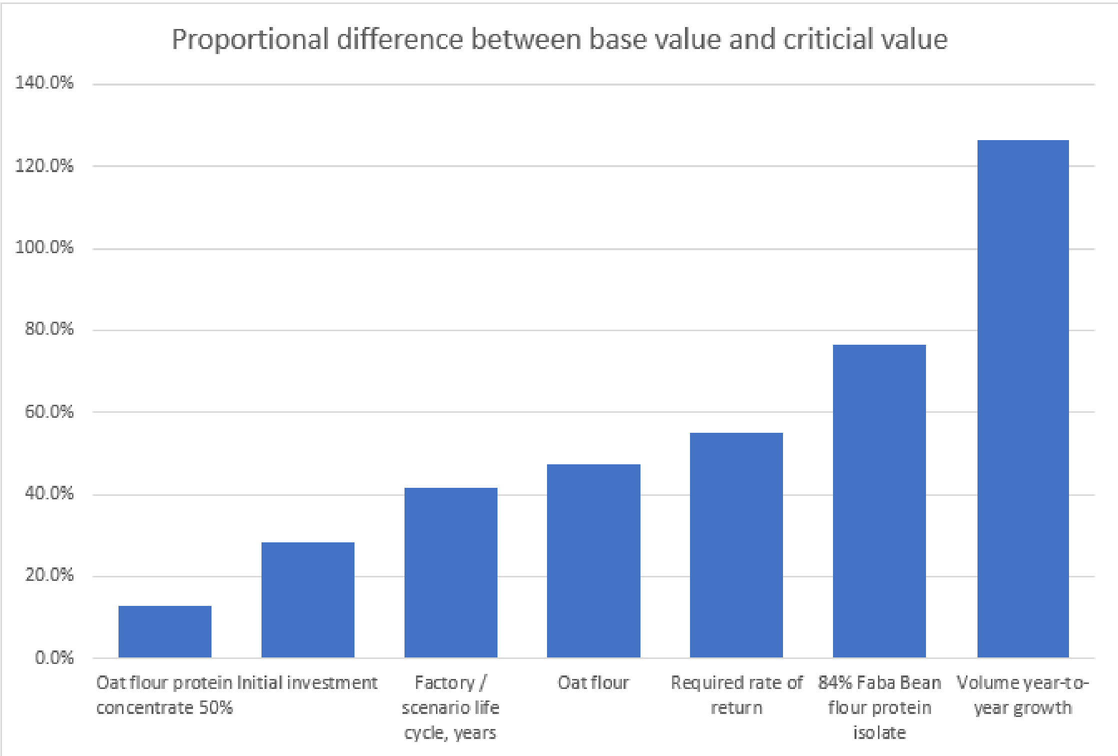

Figure 15. Results of critical value analysis expressed as a bar chart.

This critical value analysis shows the decision maker that the estimated initial investment of the factory would need to be reduced by 5,633,979€ or by 28.2% for the investment project to be reach a positive NPV and thus be acceptable under the demonstrated settings of the model. Alternatively, the life cycle would need be extended by 5 years or the price of the primary process output, the Oat protein concentrate would need to increase by 13.1%. With datapoints such as these the success criteria of the investment project can be understood more clearly. For example, knowing that a 28.2% reduction in investments is necessary for the project to yield acceptable returns a decision maker might proceed to evaluate whether such a reduction is possible.

4.2. Strategic analysis

When reading literature considering methods of investment appraisal one might get conclude that investment decision making actually involves very little decision making (at least if decision making is understood as applying genuine effort into the process of determining which one of two or more alternatives should be selected). The decision maker might come off as a rather passive figure, if decision-making is understood as simply picking the option that promises the highest net present value. This emphasis on appraisal methods is found in much of financial literature (e.g. Fogler, 1995; Adler, 2000) the assumption being that the application of the correct method will lead to the correct investment decision. As Pike & Neale (2006 p. 182) put it: “The decision-maker is viewed as having a passive role, acting more as a technician than as an entrepreneur”.

Yet, it is clear in light of strategic investment decision making literature that the strategic and non-financial aspects of the investment project cannot be ignored (e. g. Alkaraan, 2020; Cooremans, 2011). Non-financial aspects refer to data that cannot be expressed as future cash flows associated with the investment project, and as a result cannot not be included in a model such as the one described above. The strategic analysis is important to enable the application of more data and gathered wisdom in the decision-making process (e. g. Hastie, 1974; Cooremans, 2011) and to control for faulty assumptions that might have been made during the numeric investment appraisal process (Götze et al., 2015).

The purpose of this chapter is to address how the strategic aspects of the investment project should be assessed and considered in the investment decision making. Secondarily, this chapter attempts to provide managerial recommendations that stem from a strategic analysis of gathered data. The data gathering process is explained in the Methodology section.

For the strategic analysis this thesis proposes a framework combining the resource-based view (Barney, 1991) and transaction cost economics (Coase, 1937, Williamson, 1975) while framing the investment decision as a make-or-buy decision (Serrano et al., 2018, McIvor, 2009). Alternative framings considered included a focus on industry competitive forces (Porter, 1980) or technology based competitive advantage (Porter, 1985; Abdel-Kader & Dugdale, 1998). The make-or-buy decision approach was selected as the degree of vertical integration was considered the most appropriate framing while recognising that this cannot be assumed to be the correct decision. These strategic concepts are not clear-cut categories, which is to say that industry competitive forces and technological aspects will be a part of the analysis, although not centre-stage.

4.2.1. Assessing strategic aspects of the investment project

The proposed framework combines the two most popular theories employed in make-or-buy decision making literature: the resource-based view (RBV) and transaction cost economics (TCE) (Serrano et al., 2018; Dibbern et al., 2004). While RBV is an effective theory in developing understanding on how make-or-buy decisions impact the resource position and competitive advantage of the firm, TCE provides a framework for assessing how interdependencies and process idiosyncrasies expose the firm to potential opportunism (Brewer et al., 2013; McIvor, 2009).

In accordance with the RBV Valio should execute the investment project if this would lead to a strengthening in Valio’s resource position in a way that offers Valio a competitive advantage over other firms. This would be true if executing the investment project yields Valio with VRIN (valuable, rare, inimitable, non-substitutable) resources (Barney, 1991).

As a general advice TCE advises against vertical integration as market intermediation is preferred in well-functioning markets (Williamson, 1975). As an exception, vertical integration by internalising the production is advised when market intermediation carries high transaction costs (Walker & Weber, 1987; Brewer et al., 2013; McIvor, 2009). High transaction costs occur when risk for self-centred opportunistic behaviour between firms is high. This risk is high when: 1. The level of uncertainty associated with a supplier or a transaction is high. 2. Bought product or service has a high asset specificity. 3. Short-term gains for opportunistic behaviour are very large (e. g. McIvor, 2009; Hill, 1990; Williamson, 1975).

The framework combining RBV and TCE with their managerial recommendations for the make-or-buy decision is outlined in Figure 16 below.

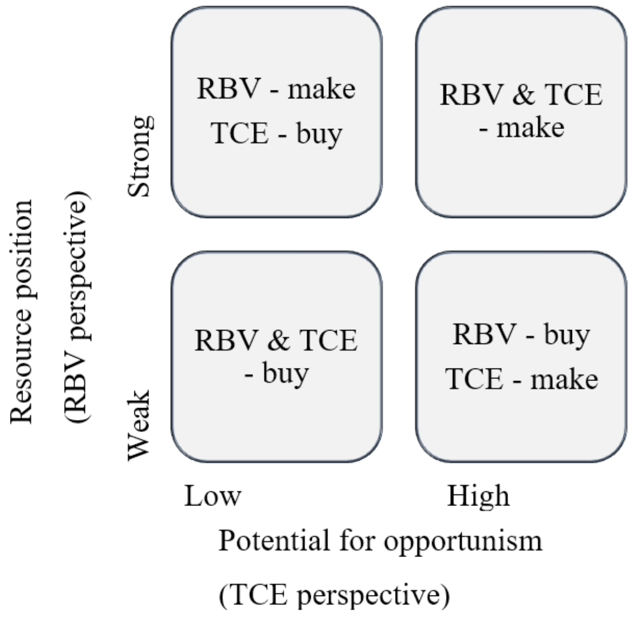

Figure 16. Proposed TCE-RBV decision-making framework.

This framework answers the research question *RQ1* of how the decision of investing in a plant-based ingredient processing facility at Valio should be taken according to recent make-or-buy decision literature. The investment project should be analysed based on how it impacts Valio's resource position and the potential for opportunism of other parties in the process of procurement of plant-based ingredients.

4.2.2. Demonstration of the use of the TCE-RBV framework

To answer the second research question, data needs to be gathered to pinpoint the correct corner the investment project should be placed in the TCE-RBV matrix (Figure 16 above). The top right corner would indicate that the investment project should be accepted from a strategic standpoint, while the bottom left corner would recommend the rejection of the project. The other two corners (bottom right and top left) would result in an inconclusive result, as the selected theories provide different recommendations in these situations. If this is the case managerial judgement must be applied to decide what factors should take primacy in the analysis.

As noted in the theoretical background section, the investment project can be considered as either an exploitative or explorative initiative depending on which project results are given primacy. If the investment project is primarily expected to provide cost savings by internalising the manufacturing of ingredients it should be considered an exploitative initiative. On the other hand, if the project is expected to lead to the development of new products and business models it should be considered an explorative initiative (Porter, 1980).

The data required to conduct this analysis is valuable strategic data, which I have very limited access to as I depend on public sources through which only a cursory knowledge of firm strategy could be applied. Similarly, I cannot be aware of the present nor future plans of Valio or its competitors, making it difficult to assess what resources might be considered VRIN-resources during the time span of the investment project. So, while recognising that the managerial usefulness of my recommendations is limited by the data I could access (and perhaps my ability to conduct clear-headed strategic analysis), recommendations for deciding between accepting and refusing the investment project are provided by demonstrating the use of the TCE-RBV matrix with empirically gathered data. The data gathering process is discussed in the Methodology section.

The presented conclusions are based on the following findings:

1. I did not find evidence of Valio holding resources that would enable it to manufacture plant-based ingredients more efficiently than competing firms.
2. I found evidence that Valio has capabilities in developing and monetising technologies used in the processing of novel ingredients. I deem it possible that these capabilities could be transferrable to plant-based ingredients.
3. I found evidence that the plant-based dairy replacements industry is growing.
4. I found evidence that other firms are increasing capacity / making investments in plant-based ingredient processing.
5. I found evidence that plant-based products are a strategic focus for Valio.

4.2.3. Assessing investment project from the RBV perspective

From the RBV perspective the investment project should be accepted if it improves Valio's resource position (e. g. McIvor, 2009). If the investment project is considered as an exploitative initiative it would seem unlikely that Valio, given its history as a dairy company, would be in possession of VRIN-resources that would enable it to produce plant-based ingredients similar to those produced by other companies in a more competitive fashion. It is also unlikely although possible, that the development of such resources would be a strategically viable path as this would entail catching up decades of experience and development in the processing of plant-based ingredients. Other companies, such as Raisio[13] and Fazer[14] are also in the process of ramping up their operations, making the market entry less appealing if no product diversification is expected. On the other hand it is possible that Valio's vast experience in running a vertically integrated operation have armed it with resources or dynamic capabilities (such

[13] https://www.raisio.com/fi_FI/raisio-investoi-45-milj.-euroa-terveellisten-elintarvikkeiden-kasvuun accessed 30.07.2020

[14] https://www.fazergroup.com/fi/medialle/uutiset/fazer-investoi-40-miljoonaa-euroa-suomeen/ accessed 30.07.2020

as knowledge and processes) that would be applicable to managing a more vertically integrated plant-based ingredient operation.

If the initiative is considered explorative, it could be imagined that Valio's strength in technical and product development and expertise in dairy could enable the development of new ingredients. As Valio's background differs from companies traditionally producing plant-based ingredients (such as firms that have a stake in the milling of grains) it is conceivable that other firms might not hold resources that would enable them to successfully compete against Valio in manufacturing these new ingredients.

Valio might hold resources that would enable the leveraging of success in the development of new plant-based ingredients or technologies used to produce them. As described chapter 1.1 Empirical, Valio has found recent success in the sales of value-added ingredients and the technologies used to produce them. Valio also has recently enlisted distribution partners to bring its ingredients to wider markets. It would be plausible to imagine that success in the development and manufacturing of novel plant-based ingredients could quickly lead to the utilisation of these established resources in the service of expanding new businesses built around these ingredients. The fact that Valio's R&D heavy businesses in licensing and value-added ingredients is currently expanding is also proof of Valio's capabilities in development of new products and technologies.

In conclusion: as an exploitative initiative the investment project would lead to a weak resource position, while as an explorative initiative the investment project could lead to a strong resource position. From the RBV-perspective the investment project is strategically viable only if its primarily and explorative initiative.

4.2.4. Assessing investment project from the TCE perspective

The TCE perspective to the make-or-buy decision asks to evaluate the risk of opportunism associated with the procurement of the product under consideration (McIvor, 2009; Williamson, 1975). As general advice, TCE advocates the use of a market exchange over internalised processes when there are no good reasons to do otherwise (Williamson, 1971)

An exception to this rule are cases where potential or risk for opportunism is high (Dibbern et al., 2004; Serrano, 2018; McIvor, 2009).

Risk for opportunism is high when the product in question (in this case the plant-based ingredients) have high asset specificity (Williamson, 1975). This would be the case of Valio as the buyer of the product holds assets that are specific to the use of the plant-based ingredients and could not be redeployed in other uses. An example of highly specific asset would be a plant-based ingredient that Valio buys from another firm and that is essential for manufacturing several products. Without that specific plant-based ingredient all the machinery used to make the products in question would be rendered useless. In such a situation the seller of the plant-based ingredient vital in Valio's operation could benefit greatly from opportunistic behaviour, such as raising prices. Therefore, the risk for opportunism is heightened, making internalising the production of the ingredient in question more strategically appealing.

Another cause for risk for opportunism is a high level of uncertainty regarding a transaction or a supplier (Williamson, 1975). Imagine that one of Valio's suppliers appears to be occasionally unable to deliver on the quality they have promised in the time frame that was agreed. In such an event Valio would be forced to seek alternative suppliers, hold extra inventory, increase the frequency of contact with the supplier or find some other way to mitigate the risk that operations suffer as a result of not having the right materials delivered at the right time. In this way the unreliability of the supplier costs Valio money and effort. The risk for opportunism is also proportional to the short-term gains of opportunistic behaviour (Hill, 1990).

To evaluate the risk of opportunism in the context of this make-or-buy decision the asset specificity of the bought or made ingredients and the uncertainty associated with buying the ingredients must be addressed.

These factors are very difficult to assess from the outside, but industry dynamics and trends can help in making a judgement. Valio (2018-2020) sees that the plant-based dairy replacing market is expanding. As we noted above other companies are currently investing into capacity to produce plant-based products and ingredients. It seems therefore likely that both the number of producers and the production volumes in the plant-based ingredient industry would rather increase than decrease. A larger number of players operating on higher volumes should decrease the risk for opportunism, as competition increases. This might however be counteracted by increased demand for the plant-based ingredients.

As it was with the analysis from the RBV perspective the exploitative or explorative nature of the investment project is also a key factor when the make-or-buy decision is considered from the TCE perspective. If the project is explorative and the intention is to develop and produce novel ingredients, it would appear logical to assume that the availability of similar products would be smaller than more general products. Also, novel ingredients would likely be more difficult to replace with other ingredients. This would indicate a higher level of asset specificity.

In conclusion: as an explorative initiative the investment project would lead to a higher risk for opportunism, which would make realising the investment project more appealing.

4.3. Synthesis of the results

Vertical integration throughout the dairy value chain is key to Valio's modus operandi as the largest dairy company in Finland. As a response to industry rivalry and a general decline in the demand of milk Valio has pursued growth in the sales of more specialised products and ingredients. Traditionally these have included, for example, lactose free dairy products and ingredients (Valio, 2016; Valio, 2020). In 2018 Valio entered the vegan dairy replacing products -market with a consumer facing Oddlygood® brand. Valio expects the significance of vegan dairy alternatives to increase over time (Valio, 2020). Therefore, the question of vertical integration through the vegan dairy alternative value chain is relevant and timely.

A possible next step for Valio to integrate further in this value chain would be the establishment of a factory to begin plant-based ingredient processing. From a strategic perspective this could be a considered both an exploitative and explorative initiative, as it would allow Valio to enter new business areas while possibly improving the cost competitiveness of the existing vegan dairy alternative product business (e.g. He & Wong, 2004; Raisch & Birkinshaw, 2008).

This thesis proposed a framework to be utilised by Valio in assessing whether Valio should establish said plant-based ingredient processing factory. In the proposed framework (Figure 17) the financial aspects and strategic aspects are analysed separately as recommended in strategic investment appraisal literature (e. g. Alkaraan & Northcott, 2006; Adler, 2000; Huikku et al., 2018).

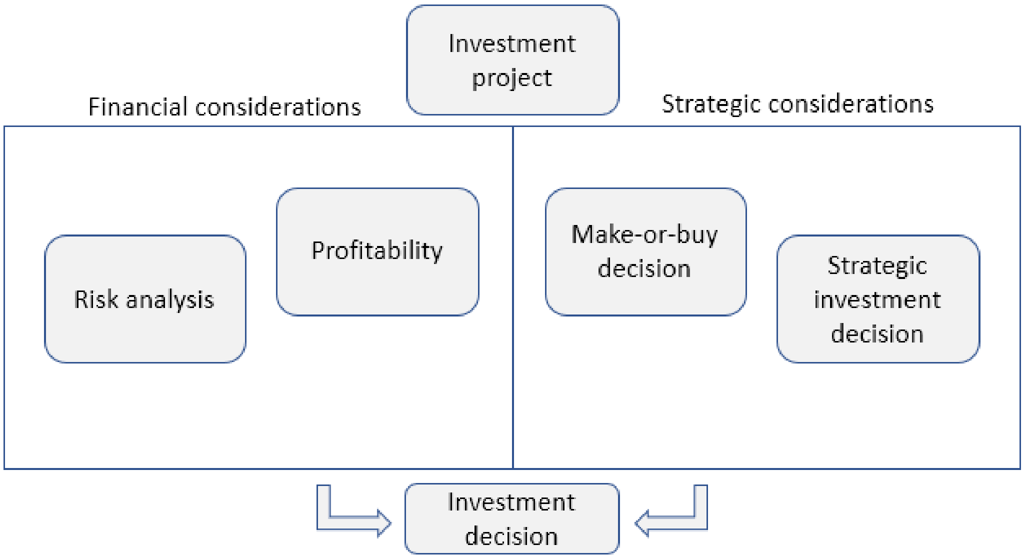

Figure 17. Proposed decision-making framework.

For the analysis of financial aspects an excel tool was created. This tool is designed to facilitate scenario analysis by including an interface to allow for the easy changing of values used in cash flow calculations. For the generation of insights, the tool or model uses the most widely used investment appraisal methods: the payback period, return on investment (ROI), accounting rate of return (ARR), net present value (NPV) and internal rate of return (IRR) (e. g. Alkaraan 2020; Huikku et al. 2018).

As a demonstration of the use of the model a set of data was gathered and analysed with the excel tool. As results of the analysis it can concluded that with the used data set the NPV of the project is negative (-5,633,974€) and the IRR 4.06% compared to the required return rate of 9%. On these grounds the project should be declined, although a return rate of 4.06% can be considered moderately appealing given that Valio's asset value has grown at an average annual rate of 1.8% over the past 15 years (Valio, 2005; 2020).

To assess risks and to provide more insight into the conducted analysis a sensitivity analysis and a critical value analysis was conducted. The price of the primary process output, Oat protein concentrate was found as the most impactful variable when the effect of relative change of inputs were assessed based on the impact their change has the project net present value. Following the price of Oat protein concentrate, the required initial investment, expected life cycle of the factory and the price of Oat flour were the second to fourth most impactful variables.

In the critical value analysis, the states of key variables that would result in the project net present value to be positive (and the project thus acceptable) were established using the Solver tool in excel. For the most impactful variables these values are listed in Table 26 below. As demonstrated, the price of the primary output, Oat protein concentrate would need be 13.1% or 1,96€ more valuable than expected for the project to be acceptable all other things remaining constant.

	Base value	Critical value	Difference Δ	ABS Difference Δ%
Factory / scenario life cycle, years	12	17	5	41.7%
Initial investment	20,000,000 €	14,366,020 €	- 5,633,980 €	28.2%
Oat flour	€ 0.80	€ 0.42	-€ 0.38	47.5%
Oat flour protein concentrate 50%	€ 15.00	€ 16.96	€ 1.96	13.1%

Table 26. Critical values of most impactful variables.

For the strategic analysis this thesis proposes a framework combining the resource-based view (Barney, 1991) and transaction cost economics (Coase, 1937, Williamson, 1975) while framing the investment decision as a make-or-buy decision (Serrano et al., 2018, McIvor, 2009). This framework is inspired by McIvor (2009) and combined the two most widely discussed theories in the make-or-buy decision literature (Serrano et al., 2018; Dibbern et al., 2004).

The outcome of the analysis is dependent on the judgement of the investment project regarding its exploitative versus explorative nature. As the project has facets that touch with both the judgement was cast separately for the two perspectives.

From the resource-based view (RBV) the investment project should be accepted if doing so improves Valio's resource position (e. g. McIvor, 2009). From an exploitative perspective this would require the cost competitiveness of Valio's vegan dairy replacing products to improve resulting from internalising the production of plant-based ingredients used in these products. From the RBV this would be true if after building the factory Valio would be in possession of valuable, rare, inimitable and non-substitutable (VRIN) resources.

It is conceivable that Valio would be in possession of resources that enable it to run a vertically integrated production operation from a position of competitive advantage. Valio would however be competing against companies with already established production processes and more experience in the manufacturing of plant-based ingredients. Therefore, it seems unlikely that Valio would be in the possession of VRIN-resources that are vital in the manufacturing of plant-based ingredients currently found on the market.

However, if the intent of the operation is to develop and produce novel ingredients it is perhaps more likely that Valio could have a stronger resource position in relation to the production of these ingredients. Valio has experience in the development of technologies and business models that have brought it success with, for example, lactose free dairy ingredients. This same expertise could perhaps be utilised to develop new plant-based ingredients.

The second point of view used in the strategic analysis of the investment project is the transaction cost economics (TCE). As a general advice TCE advises against vertical integration as market intermediation is preferred in well-functioning markets (Williamson, 1975). As an exception, vertical integration by internalising the production is advised when market intermediation carries high transaction costs (Walker & Weber, 1987; Brewer et al., 2013; McIvor, 2009).

High transaction costs occur when risk for self-centred opportunistic behaviour between firms is high. This risk is high when: 1. The level of uncertainty associated with a supplier or a transaction is high. 2. Bought product or service has a high asset specificity. 3. Short-term gains for opportunistic behaviour are very large (e. g. McIvor, 2009; Hill, 1990; Williamson, 1975).

Valio expects the vegan dairy replacement market to grow (Valio, 2020). This increases the demand for the ingredients used in the manufacturing of these products. On the other hand, the supply might also be increasing as multiple companies have announced investments in the new facilities producing plant-based ingredients. While the growing demand increases the risk for opportunism by enabling producers to possibly increase prices and by growing the risk of producer inability to fulfil all orders, the growing supply decreases the risk of opportunism by decreasing reliance on single suppliers and decreasing the risk of shortages.

If the investment project is considered as merely internalising the production process of ingredients its strategic viability from the TCE perspective depends on the expected industry dynamics. If demand is expected to grow faster than supply, so that the secured availability of the ingredients is likely to be compromised, the project should be accepted and declined in other cases.

If however the project is considered as explorative and it is expected that the factory would produce ingredients that enable the production of new kinds of vegan dairy alternative products, the higher asset specificity of the outputs make the investment project more appealing. It is likely that such new ingredients would be difficult to procure and therefore realising the investment project to gain access to such new ingredients seems strategically viable.

In conclusion the TCE and RBV lenses seem to be in line regarding their recommendations. If the project is considered as an exploitative, cost savings initiative it is most likely not strategically viable. If the project is seen as an explorative initiative, including the development of new products that can be used in the production of new and improved vegan dairy alternative products, the project is strategically viable. This result is shown in Figure 18 below.

In either case the financial viability of the project must also be addressed, as both lenses should support the acceptance of the investment project before it is accepted.

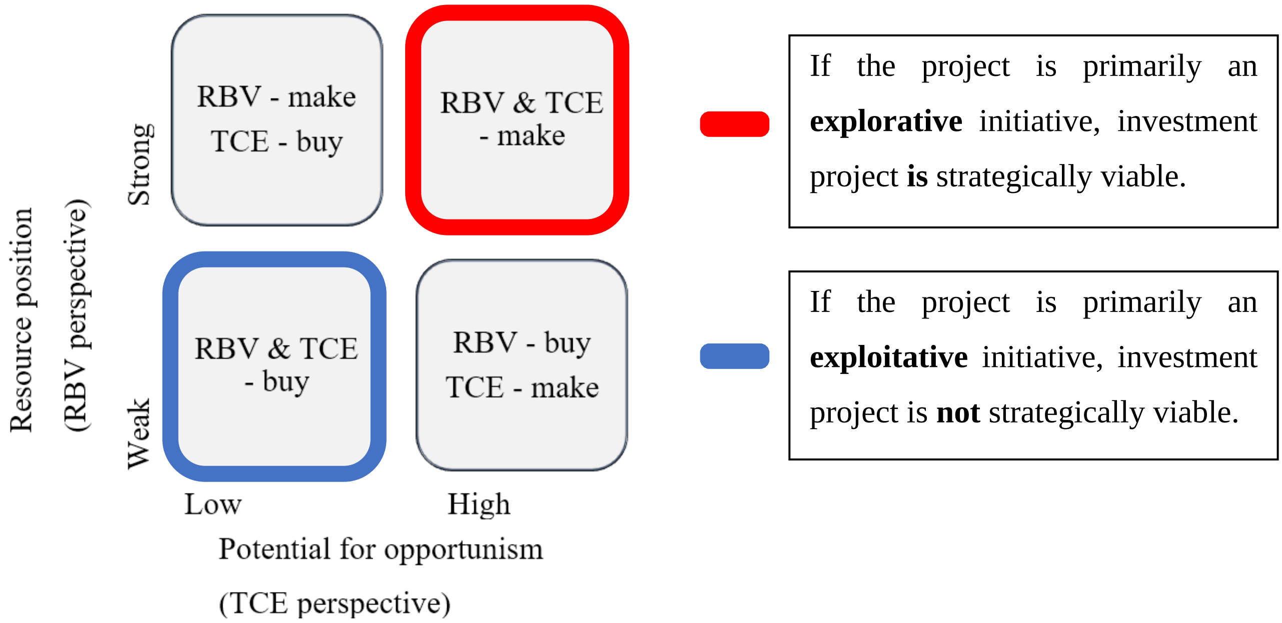

Figure 18. Recommended action based on strategic analysis.

5. Discussion

The purpose of this study was the construction of a strategic investment decision-making construct that could be deployed to assess whether Valio should build capacity for plant-based ingredient processing. The research was conducted following constructive research methodology and in constant collaboration with the client.

The ideal outcome of a constructive research process is the successful solving of the problem with the implementation of the created construct in a way that produces a great contribution from a practical and a theoretical point of view (Lukka, 2003). In this chapter these contributions are discussed, limitations of this study are discussed, and areas for further research are identified.

The research questions this thesis aimed to answer were:

> *RQ1:* How should the decision of investing in a plant-based ingredient processing facility at Valio be taken according to recent make-or-buy decision and strategic investment decision making literature?

RQ2: Should Valio invest in a plant-based ingredient processing facility based on the data that could be gathered?

5.1. Practical and theoretical contributions

This thesis shows that the real-life strategic investment problem can be addressed with the created construct.

In literature covering numeric investment appraisal techniques remarkable uniformity was found. The use of methods such as payback period, return on investment (ROI), accounting rate of return (ARR), net present value (NPV) and internal rate of return (IRR) is documented widely and the use of these methods is a central part of finance textbooks (e. g. Alkaraan 2020; Huikku et al. 2018; Götze et al., 2015; Alkaraan & Northcott, 2006; Pike & Neale, 2006).

On the other hand, these methods are criticised on their narrow focus and inability to include all relevant information in the investment decision making process (e. g. Adler, 2000; Götze et al., 2015). While some scholars (e. g. Adler, 2000) have proposed new and more sophisticated numeric investment appraisal methodologies, most scholars advocate the pairing of numeric investment appraisal with a strategic analysis (e. g. Alkaraan & Northcott 2006; Carr et al., 2010).

Especially when analysing investment projects with significant strategic implications, the clear recommendation in the investment appraisal literature is to employ strategic, non-financial analysis methods along numeric techniques, as the numeric analysis is guaranteed to miss important facets important to the decision (e. g. Alkaraan & Northcott, 2006; Cooremans, 2011). This recommendation found in literature was brought over to the constructed decision-making framework. The approach proved useful in practice: the construct was able to capture both strategic and financial aspects of the investment project in an appropriate manner.

The construct and recommendations were well received by the client. As summarised by a Valio representative: *"The Excel tool is good for our purposes and it can be utilised in* *making decisions regarding this (investment) case as new information is discovered. It (the Excel tool) can also be used in the analysis of completely different investments".*

This feedback shows that the Excel tool facilitated scenario analysis as was intended, which provided Valio with valuable insights in the financial implications of different variations of an investment project. With the provided documentation the client feels that they can update the Excel model with new information and generate similar models for other purposes. It is reasonable to think that other companies, also in other industries, might benefit from the imitation of the logic and design of the Excel model.

The results are therefore transferable at least to some degree to any manufacturing investment decision-making, where the problem can be framed as a make-or-buy decision. As a representative from Valio notes that: *"the framework is applicable for use also in other companies for the evaluation of strategically complex investments".*

This thesis contributes to the wider audience of both researchers and practitioners by providing a decision-making construct that has a wide range of potential applications. This thesis also shows how the construct was constructed and details its link to theory in every step of the way, which forms the basis for a meaningful contribution (Lukka, 2003; Kasanen et al., 1993).

In constructive research, theoretical contribution springs from two sources. Firstly, the construct that has been constructed during the research process contributes to theory. Further contribution can be drawn from the

The primary academic contribution of this thesis is the connected use of a strategic make-or-buy decision-making framework and an Excel tool based on the most widely use investment appraisal methods. The developed make-or-buy decision-making construct builds on the framework developed in McIvor (2009) by expanding its use from outsourcing decisions to manufacturing investment decision-making.

McIvor (2009 p. 62) calls for other researchers to test the TCE-RBV framework in other research settings. Brewer et al. (2013) partially validated the framework in their research but call for more research to be conducted in other contexts. Both studies deploy a TCE-

RBV logic in addressing a make-or-buy decision. This thesis contributes to these works by using the TCE-RBV logic in a novel decision-making setting.

5.2. Limitations and further research

Lukka (2013, p. 97-98) identifies four sources of potential trouble in the constructive research process. These are acknowledged as limitations of this research:

1. The things that get uncovered during the research process might be too delicate or confidential to include in a research paper.

2. The commitment of the client organisation wavers during the research process.

3. It is challenging for the researcher to be involved in the process and committed to solving the case problem while maintaining academic neutrality.

4. While the constructive research methodology remains unconventional, the results might not be considered as legitimate contributions to science.

Risks 1. and 2. could be mostly tackled. The commitment of the client remained very strong for the entire duration of the process, which explains the successful development and deployment of the solution construct. The research process was conducted in constant exchange with a project team of Valio staff. The case in question is strategically relevant to the client. As a result, it is no surprise that not all relevant data could be used in the research process.

The data used in the financial model originates almost exclusively at the client. The source reference used in the model is “client estimate” for data gathered this way. Some discussions regarding strategic matters also took place, but a conscious effort was expressed not to discuss confidential matters. This was mostly successful and as a result I was able to discuss strategic matters in the results section from the point of view of a curious outsider.

This partly mitigates risk 3. regarding academic neutrality. The recommendations of this thesis are based on publicly available material and it is therefore likely that many strategically important factors are excluded from this study. Data that is relevant in strategic decision making can be difficult to obtain. This can lead to data that could be gathered for the purposes of this thesis to have an exaggerated effect on given recommendations as it is not properly balanced by other sources. The analysis is also conducted by an industry outsider, which while a potential source of a fresh perspective can result in failure to include important industry dynamics in the analysis.

This thesis is based on a limited number of theories and methods in a near limitless pool of literature. Although my ambition was to engage with the whole breadth of relevant literature, not all gaps could be closed. The selection of theories and methods is also based on the authors limited understanding of the investment project under consideration. As a result, it is very likely that very important elements of the investment project are left outside of this study.

The methods used in this thesis were selected so that only basic mathematical understanding is required to make sense of presented formulae and calculations. This was done to ensure relevance of findings for practitioners without extensive mathematical training or access to specialist software. This ruled out some modern computer aided investment appraisal techniques, such as sophisticated simulations, which could provide very valuable insights if deployed in the analysis of this case.

It is worth noting that much of the make-or-buy decision literature cited in this thesis focuses on making outsourcing decisions. In this thesis a view is taken that the decision to insource or to outsource are both expressions of the make-or-buy decision and both can be addressed using the same theories.

Finally, as the data tables and process charts presented in the results contain sensitive information total transparency was not possible. Some of the data is coded and some datapoints are not broken down in way that would be necessary for the reader to be fully able to comprehend what exactly is being calculated. This does not diminish the usability of the results for their intended purpose but might make the results section slightly more difficult to follow for others. This implies that the final risk (4.) highlighted by Lukka (2003) regarding scientific contribution realised to some degree.

During the research process two avenues for further research were identified. First is the expansion of the scope of the financial lens with the inclusion of newer investment appraisal methods. Especially the real options logic to investment appraisal, which is regarded among the most promising modern appraisal methods, could offer new points of view to complement the construct (Baker et al., 2010; Lander & Pinches, 1998).

The second is the scope of theories included in the strategic lens. This thesis focuses on the TCE and RBV perspective. This leaves out the relationship theories, agency theory, social exchange theory, game theory, innovation theories and power and politics theories (Serrano et al., 2018). These theories would likely bring valuable new insight to the analysis of the investment project.

6. Conclusion

Valio expanded to the vegan dairy replacements market when it launched its plant-based Oddlygood® brand in 2018. Valio estimates that the significance of this market will grow over time and notes its business based on vegan products as one of its main strategic focus areas (Valio, 2020).

While vertical integration through the entire value chain is a key characteristic of Valio’s dairy business, its operation in plant-based dairy alternatives currently only covers the manufacturing and marketing of end products. Vertical integration can be a source of improved competitiveness, leading to increased profits (Klein, 2005; Williamson, 1975).

Valio might want to consider internalising the production of plant-based ingredients used in vegan dairy replacing products, and by doing so increase the level of vertical of the vegan dairy replacements business. This would require the establishment of a plant-based ingredient processing facility. In this thesis the idea of establishing a plant-based ingredient processing facility is referred to as the investment project.

The purpose of this study was to produce a construct that can be applied in making this investment decision. This research was conducted following the constructive research approach (Lukka, 2003; Kasanen et al., 1993).

The investment project was classified as a strategic investment project, as it would result in installation of new manufacturing processes and result in a substantial shift in production capabilities. Therefore, As recommended in strategic investment decision-making literature, the investment project was assessed from a financial and strategic point of view (Slagmulder et al., 2015; Alkaraan & Northcott, 2006).

For the analysis of financial aspects an excel tool based on the most common investment appraisal methods was constructed. The use of the tool was demonstrated using a data set provided by the client and results reported in the results section. Based on this demonstration the investment project should be rejected as its net present value is negative. The data on which this result is based on is however speculative and this result should be updated once new data is available. To facilitate further use of the Excel tool multiple scenario analysis features were added.

Strategic analysis was conducted through a make-or-buy decision framework based on the two most commonly applied theories found in make-or-buy decision literature: the resource based view (RBV) and transaction cost economics (TCE) (Serrano et al., 2018; Dibbern et al., 2004). The use of the framework was then demonstrated.

The results of this demonstration are in line with make-or-buy decision literature where the make option is often associated with specialisation and the buy option with cost savings (Brewer et al., 2013; McIvor, 2009). Based on empirical findings support for realising the investment project as an explorative initiative, aimed at the development of new products and technologies was found. However, if the investment project is viewed as merely an exploitative project aimed at generating cost savings, it should not be realised based on the findings of this thesis.

The produced decision-making construct can be applied in strategic investment decision-making in any manufacturing firm whilst keeping in mind the limitations of the selected approach, namely the exclusive focus on the firm as the unit of analysis in the strategic evaluation of an investment project.

7. References

Abdel-Kader, M.G. & Dugdale, D., (1998). Investment in advanced manufacturing technology: a study of practice in large U.K. companies. *Management Accounting Research,* 9(3), pp. 261-284.

Adler, R. W. (2000). Strategic investment decision appraisal techniques: the old and the new. *Business Horizons*, 43(6), 15-22.

Alkaraan, F. (2020). Strategic investment decision-making practices in large manufacturing companies: A role for emergent analysis techniques, *Meditari Accountancy Research*, Vol. ahead-of-print No. ahead-of-print.

Alkaraan, F., & Northcott, D. (2006). Strategic capital investment decision-making: A role for emergent analysis tools?: A study of practice in large UK manufacturing companies. *The British Accounting Review*, 38(2), 149-173.

Ansoff, H. I. (1965). Corporate strategy: An analytic approach to business policy for growth and expansion. *McGraw-Hill Companies*.

Ansoff, H. I. (1980). Strategic issue management. *Strategic management journal*, 1(2), 131-148.

Arla Foods. (2019), Annual report

Arnold, T., & North, D. (2011). Risk simulation concepts and methods. In Baker, H. K., & English, P. Capital budgeting valuation: Financial analysis for today's investment projects. *John Wiley & Sons*: Ch 15, 279-298.

Baker, H. K., Dutta, S., & Saadi, S. (2011). Management Views on Real Options in Capital Budgeting. *Journal of Applied Finance*, 21(1), 18.

Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of management*, 17(1), 99-120.

Brewer, B. L., Ashenbaum, B., & Carter, J. R. (2013). Understanding the supply chain outsourcing cascade: when does procurement follow manufacturing out the door?. *Journal of Supply Chain Management*, 49(3), 90-110.

Carr, C., Kolehmainen, K., & Mitchell, F. (2010). Strategic investment decision making practices: A contextual approach. *Management Accounting Research*, 21(3), 167-184.

Chandler, A. D. (orig. 1962). Strategy and structure: Chapters in the history of the industrial enterprise (Vol. 120). *1990 MIT press*.

Chembid, (2020). https://www.chembid.com/ , quotes for “Sodium Hydroxide” and “Nitric acid”, *searched for and accessed 28.07.2020*

Coase, R.H., (1937) The Nature of the Firm. *Economica, New Series* 4(16), 386-405.

Cooremans, C. (2011). Make it strategic! Financial investment logic is not enough. *Energy Efficiency*, 4(4), 473-492.

Dean, J. (1953). Better management of capital expenditures through research. *the Journal of Finance*, 8(2), 119-128.

Dibbern, J., Goles, T., Hirschheim, R., & Jayatilaka, B. (2004). Information systems outsourcing: a survey and analysis of the literature. *ACM SIGMIS Database: the DATABASE for Advances in Information Systems*, 35(4), 6-102.

Doz, Y., Prahalad, C. K., & Hamel, G. (1990). Control change, and flexibility: the dilemma of transnational collaboration. Bartlett et al. *Managing the Global Firm*, 117-143.

Dyer, J. H., & Singh, H. (1998). The relational view: Cooperative strategy and sources of interorganizational competitive advantage. *Academy of management review*, 23(4), 660-679.

Eisenhardt, K. M., & Martin, J. A. (2000). Dynamic capabilities: what are they? *Strategic management journal*, 21(10-11), 1105-1121.

Eloranta, V., & Turunen, T. (2015). Seeking competitive advantage with service infusion: a systematic literature review. *Journal of Service Management*, 26(3), 394-425.

Fogler, H. R. (1995). Investment analysis and new quantitative tools. *Journal of Portfolio Management*; 21(4), 39-48

Ghoshal, S., & Moran, P. (1996). Bad for practice: A critique of the transaction cost theory. *Academy of management Review*, 21(1), 13-47.

Götze, U., Northcott, D., & Schuster, P. (2015). Investment Appraisal. *Springer*.

Hastie, K. L. (1974). One businessman's view of capital budgeting. *Financial Management*, 36-44.

He, Z. L., & Wong, P. K. (2004). Exploration vs. exploitation: An empirical test of the ambidexterity hypothesis. *Organization science*, 15(4), 481-494.

Hill, C. W. (1990). Cooperation, opportunism, and the invisible hand: Implications for transaction cost theory. *Academy of management review*, 15(3), 500-513.

Hitt, M. A., Keats, B. W., & DeMarie, S. M. (1998). Navigating in the new competitive landscape: Building strategic flexibility and competitive advantage in the 21st century. *Academy of Management Perspectives*, 12(4), 22-42.

Huikku, J., Karjalainen, J., & Seppälä, T. (2018). The dynamism of pre-decision controls in the appraisal of strategic investments. *The British Accounting Review*, 50(5), 516-538.

Kallioinen, H. (2020). Add value to your liquid milk business and launch lactose free milk easily, https://www.valio.com/food-solutions-for-companies/articles/add-value-to-your-liquid-milk-business, *accessed 02.06.2020*

Karjuhoki, H. (2013). Valio ajan hermolla jo vuodesta 1905, https://www.valio.fi/yritys/artikkelit/valio-ajan-hermolla-jo-vuodesta1905, *accessed 01.06.2020*

Kasanen, E., Lukka, K., & Siitonen, A. (1993). The constructive approach in management accounting research. *Journal of management accounting research*, 5(1), 243-264.

King, P. (1975). Is the emphasis of capital budgeting theory misplaced?. *Journal of Business Finance & Accounting*, 2(1), 69-82.

Kraaijenbrink, J., Spender, J. C., & Groen, A. J. (2010). The resource-based view: a review and assessment of its critiques. *Journal of management*, 36(1), 349-372.

Lamprinakis, L. (2012). Organizational innovation and institutional change: the case of Valio in Finland. *International Journal on Food System Dynamics*, 3(2), 95-105.

Lamprinakis, L. (2015), "Participative organizational change and adaptation: insights from a qualitative case study of successful change", *Development and Learning in Organizations*, 29(2), 10-13.

Lander, D. M., & Pinches, G. E. (1998). Challenges to the practical implementation of modeling and valuing real options. *The quarterly review of economics and finance*, 38(3), 537-567.

Leporanta, K. (2015). Valion osaamisella kysyntää kansainvälisestikin, https://www.valio.fi/yritys/media/kuukauden-puheenvuoro/valion-osaamisella-kysyntaa-kansainvalisestikin, *accessed 02.06.2020*

Lukka, K. (2003). The constructive research approach. Case study research in logistics. *Publications of the Turku School of Economics and Business Administration, Series B*, 1(2003), 83-101.

March, J. G. (1978). Bounded rationality, ambiguity, and the engineering of choice. *The Bell Journal of Economics*, 587-608.

March, J. G. (1991). Exploration and exploitation in organizational learning. *Organization science*, 2(1), 71-87.

McGrath, R. G. (1997). A real options logic for initiating technology positioning investments. *Academy of Management Review*, 22(4), 974-996.

McIvor, R. (2009). How the transaction cost and resource-based theories of the firm inform outsourcing evaluation. *Journal of Operations management*, 27(1), 45-63.

Metropolis, N., & Ulam, S. (1949). The Monte Carlo method. *Journal of the American Statistical Association*, 44(247), 335-341.

Moss, Charles B. (2013). Agricultural Finance, *Routledge.*

Peteraf, M. A., & Barney, J. B. (2003). Unraveling the resource-based tangle. *Managerial and decision economics*, 24(4), 309-323.

Pike, R., & Neale, B. (2006). *Corporate finance and investment: decisions & strategies*. Pearson Education.

Plecher, H. (2020) Finland: Inflation rate from 1984 to 2021 (compared to previous year). https://www.statista.com/statistics/328324/inflation-rate-in-finland/, *accessed 01.06.2020*

Porter, M. E. (1979). How competitive forces shape strategy. *Harvard Business Review*. 57(2), 137-145.

Porter, M. E. (1985). Technology and competitive advantage. *The Journal of Business Strategy*, *5*(3), 60.

Raisch, S., & Birkinshaw, J. (2008). Organizational ambidexterity: Antecedents, outcomes, and moderators. *Journal of management*, 34(3), 375-409.

Santonja et al., (2019), European commission, Best Available Techniques (BAT) Reference document for the Food, Drink and Milk industries.

Serrano, R. M., Ramírez, M. R. G., & Gascó, J. L. G. (2018). Should we make or buy? An update and review. *European Research on Management and Business Economics*, 24(3), 137-148.

Stat.fi (2018), Sähkön hinta nousussa vuoden ensimmäisellä neljänneksellä, https://www.stat.fi/til/ehi/2018/01/ehi_2018_01_2018-06-12_tie_001_fi.html *(accessed 28.07.2020)*

Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic management journal*, 18(7), 509-533.

Tushman, M. L., & O'Reilly III, C. A. (1996). Ambidextrous organizations: Managing evolutionary and revolutionary change. *California management review*, 38(4), 8-29.

Valio (2016) Annual report 2015

Valio (2017-2020), Annual reports 2017, 2018 and 2019

Valio (1995-2009), Annual reports 1994 - 2008

Verbeeten, F. H. (2006). Do organizations adopt sophisticated capital budgeting practices to deal with uncertainty in the investment decision?: A research note. *Management accounting research*, 17(1), 106-120.

Walker, G. and Weber, D., (1987) Supplier Competition, Uncertainty, and Make-or-Buy Decisions. *Academy of Management Journal*, 30(3), pp. 589-596.

Welch, J. A., & Nayak, P. R. (1992). Strategic sourcing: a progressive approach to the make-or-buy decision. *Academy of Management Perspectives*, 6(1), 23-31.

Williamson, O. E. (1971). The vertical integration of production: market failure considerations. *The American Economic Review*, 61(2), 112-123.

Williamson, O. E. (1975). Markets and hierarchies: Some elementary considerations. *American Economic Review*, 63(2), 316-325.

Ziedonis, A. A. (2007). Real options in technology licensing. *Management Science*, 53(10), 1618-1633.